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ANNUAL REPORT OF

APPALACHIAN FOREST EXPERIMENT STATION

FOR 1938

Asheville, North Carolina

January 1, 1939

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The Appalachian Forest Experiment Station, with headquarters at Asheville, North Carolina, is one of 12 regional forest experiment stations maintained by the Forest Service of the U. S. Department of Agriculture. Its territory is Virginia, West Virginia, North Carolina, South Carolina, northern Georgia, eastern Tennessee, and eastern Kentucky, including both public and privately owned forest lands.

The Station was established July 1, 1921, with a staff of four technicians and one clerk. In the 17-1/2 years since that time, the technical staff has been increased to 25 in an effort to keep pace with the phenomenal development of forestry activities everywhere in the Station's territory. New lines of research have been added to meet ever-increasing demands for the basic information needed to manage in an efficient and effective fashion about 75 million acres of forest land. Until recently this Station was the only forest research organization in the region and still is counted on to carry most of the forest research load of the region.

That the work of the Station has been worth while is evidenced by a constantly increasing number of requests for technical forestry information and advice. These "service" calls now take about one-third of the total time of staff members and, although actual research obviously is correspondingly slowed down, they are regarded as high priority jobs and a definite part of the Station's work.

THE WORK OF THE STATION

The research program of the Station must be kept flexible so that changing needs of forest land administrators can be met promptly. Many of these needs must be anticipated years in advance because forest fact-finding often is a slow process depending on the growth or other reactions of trees over long periods.

In order that results may be obtained reasonably fast, the Station's research activities are concentrated on relatively few types of problems. At present these are: (1) a region-wide forest survey, (2) timber cutting methods, (3) forest planting, (4) forest measurements, (5) fire control, (6) watershed management, and (7) flood control surveys. Through cooperative arrangements with other agencies in the U. S. Department of Agriculture, research in forest pathology and entomology also is carried on.

The Forest Survey

A basic requisite of all land-use planning activities in the region is definite information on the forest resources -- how much timber there is; its condition; where it is; what species predominate; how much land is forested; how much wood is added annually by growth; how much is lost annually by cutting, fire, insects, and disease; and what the probable future requirements for forest products are likely to be. Only with such definite facts is it possible to develop sound forestry policies and programs.

This stock-taking job has been in progress in the Appalachian Station's territory for a little less than three years. About 56-1/2 million acres have been covered; approximately 64 million acres remain to be surveyed. The magnitude of this project is partially indicated by the record of 7,034 miles of cruise line and 56,276 sample plots thus far measured. Field work has been completed in North Carolina and South Carolina and most of the office computations are finished for these two states. Reports already are in process of compilation and probably can be issued early in 1939.

In North Carolina, preliminary Survey figures show large increases in both amount of timber and in use of forest products above previous estimates. The best previous estimate of total net sawtimber volume in the state was 19.4 billion board feet, whereas Survey results show 43 billion board feet. Almost two-thirds of the total volume of timber in the state is in the coastal plain; about one-fourth is in the Piedmont Plateau; 12 percent is in the mountains. Two-thirds of North Carolina's timber is softwood species.

The Survey results also show a very much higher volume of use than previously estimated. Preliminary figures for use of timber in 1937 show a lumber production of about 1.5 billion board feet by 3,025 sawmills, whereas in 1936 (a comparable year) the Bureau of the Census reported a production of only 0.8 billion board feet by 840 sawmills.

One of the outstanding results of the Forest Survey is more reliable figures for lumber production. These have been obtained by a systematic mill-to-mill canvass covering the entire state. During the past year arrangements were made to assist the Bureau of the Census in obtaining these lumber production figures. Under this plan the Station will receive and edit Census questionnaires and make such field checks as are necessary to insure accurate returns. At present the system is being tried out only in North Carolina.

Although reports summarizing Survey results have not yet been completed, the Station literally has been swamped by requests for Survey findings. For example, the influx of pulp mills into the South during the past three years was preceded by a flood of requests for information which would indicate the best place to locate these large-scale investments. The various state and Federal planning commissions

constantly are requesting information which only the Forest Survey can supply. Another "service" job of the Forest Survey was to provide on short notice information on the character and extent of all pulpwood resources in the South.

The Joint Congressional Committee, appointed during 1938 to investigate and report on forest conditions throughout the nation, has drawn heavily on Forest Survey findings; this Station spent nearly a month compiling detailed information desired by the committee. The State Foresters of both North Carolina and South Carolina have been furnished with advance figures for forestry conditions in their respective states as indicated by the Forest Survey. Chambers of Commerce, consulting foresters, state and Federal officials, and a very large number of individual citizens, have sought and obtained from the Forest Survey definite answers to questions concerning the forest resources of the states thus far covered by the Survey.

Watershed Management

The availability of plentiful supplies of usable water controls to a considerable extent the prosperty and further development of much of the Appalachian Station's territory. The value of forest cover in stabilizing streamflow and in controlling soil erosion has only recently been fully appreciated by the general public. Costly investments in hydroelectric power plants and in domestic water supply systems can be safeguarded by proper watershed management.

The Station recognizes the public value of research in this field. The flow of 37 small mountain streams on three of the Station's experimental forests is under daily observation by means of weirs with recording apparatus, and precipitation and other records are taken on feeding slopes. The basic information thus obtained is indicating how watersheds should be handled in order to produce maximum yields of usable water.

An example of the Station's basic research in forest influences is the solution last year of a problem which has perplexed foresters and engineers dealing with water problems. The rapid rise after a heavy storm of certain streams originating on forested areas heretofore has been interpreted as resulting from overland flow. Results of Station experiments now clearly demonstrate that these forest streams rise during heavy storms not because of overland flow but because storm water reaches the stream as subsurface storm flow following natural drainage lines relatively close to the surface as contrasted with the normal ground water seepage that supplies the fairly uniform base flow of all forest streams. These studies explain why relatively large amounts of storm water are carried by streams from watersheds controlled by old-field forests that have become established on abandoned and depleted agricultural land. The explanation is that the disturbed soil profiles on these old fields may be unusually favorable to subsurface storm flow even though overland storm flow is almost entirely absent. It has also

been shown that the rise of small streams from forested areas at the time of light rains is due almost entirely to channel interception rather than to storm water falling in the drainage area elsewhere. Such clarification of forest streamflow relationships leads to a better understanding of the advantages and limitations of forest cover in regulating streamflow.

The information obtained through fundamental research such as this has been put to practical use all over the region. For example, during the past year the Station assisted a North Carolina city by examining its municipal watershed and recommended the minimum measures needed for maintenance of adequate water supplies. In this particular instance the Station was asked to estimate the probable effect on quantity and quality of water supplies if all or portions of the city watershed were logged.

The Station has been of service to other municipalities in various ways. For example, one Virginia city has experienced considerable difficulty in keeping its harbor free of silt accumulations. The expense of dredging this silt accumulation at least twice yearly and of providing space for dumping the debris has given the city commissioners much concern. A member of the Station staff visited the area, discovered that the real source of the silt was inside the city limits, and made definite recommendations for curing this trouble once and for all by treating the cause rather than the result.

Another instance of application of research results: During the past few years the various relief programs of public agencies have resulted in many miles of new road construction and in mountainous or hilly country there is likely to be a great deal of erosion from bare soil on the many cut and fill slopes. In far too many instances the serious consequences of roadside erosion have been ignored. The result is increased cost of road maintenance, severe silting of many streams, and impairment of water-producing capacities of watersheds. Public opinion has forced attention to this problem and attempts are now being made to stabilize the soil on cut slopes and fills. Unfortunately, the failure to plan for erosion control at the time the roads were constructed has in many instances made the stabilization of roadbanks difficult and expensive. The Station has worked on this problem for several years and during 1938 made extensive reexaminations of its field tests, revised the recommended technique where necessary, and issued definite recommendations for soil stabilization on road banks. The Station has devised a method which appears to be satisfactory in the majority of instances, is reasonably certain, and has the decided advantage of being cheap enough for application on a large scale. During 1938 a total of about four months' time of one man was spent in training men from various public agencies in the technique of roadbank fixation.

Another service job of importance was the analysis of watershed problems on several eastern national forests which are of high value as producing areas for the domestic water supplies of several hundred

communities. In some of these communities water supplies already are inadequate to meet present demands, and further growth of the towns is restricted because of water scarcity. Definite recommendations, based on fundamental research by the Station, have been made for the correction of unfavorable land conditions, and for the future handling of important watersheds to insure maximum yields of usable water.

Flood Control Surveys

Extensive flood damage in various parts of the United States led Congress to order widespread studies of flood control, and the Department of Agriculture was instructed to work with the War Department in making these surveys. Preliminary examinations are made of specific watersheds to determine if floods are likely to occur and the magnitude of possible flood damage. If these preliminary examinations indicate that a flood control program would return its cost in minimizing damage, a more detailed survey is authorized. This detailed survey locates the flood source and outlines what needs to be done in the watershed to lessen opportunities for floods to occur and to lessen damages if any do occur. The present plan is to follow up the detailed flood control surveys with an action program based on recommendations of the detailed survey.

During 1938, the Station, with representatives of other bureaus in the Department of Agriculture, made preliminary flood control examinations and reports for two drainages. Field work was done on preliminary surveys of eight other drainages for which reports are now being prepared. A detailed survey of the Coosa River above Rome, Georgia, an area of approximately 4,000 square miles, was started in the fall of 1938 and is expected to be completed late in 1939 with definite recommendations for an action program.

Forest Planting Research

Planting research has been in progress at the Appalachian Station for only one year. About 45 million trees are planted in the region each year by public and private agencies. The most difficult planting problem in the region is on mountain lands from which dense forests of spruce and balsam have been removed by fire or logging. About 50,000 acres of such land is in Federal ownership; an even larger acreage is still in private ownership. On these denuded areas there are few sources of natural regeneration and reforestation apparently will have to be by planting. Planting costs, however, have been excessive (about $20 per acre) and less than two-thirds of the planted trees are now living. A preliminary study by the Station in 1938 indicated that survival of planted seedlings on these areas is not particularly influenced by soil type, but is strongly affected by density of herbaceous vegetation surrounding the planted trees. The Station therefore will try to find some method of overcoming the competition of bracken fern, blackberry vine, golden rod, and similar vegetation so as to increase tree survival and decrease ultimate planting costs.

A brief study was made of methods used to measure survival of trees in forest plantations. It was found that the customary procedure of counting trees in staked rows is not only expensive but frequently leads to erroneous evaluations of tree survival. A new method for measuring plantation success was devised which gives reliable results at no increased cost over the staked-row method.

In cooperation with the Tennessee Valley Authority, eight experiments dealing with planting problems on abandoned farm land were started in 1938. The purpose of these experiments is to find out which tree species are best adapted to planting on abandoned agricultural lands of the Cumberland foothills in Kentucky and Tennessee. A side-light on this study is the excellent results already obtained by seed-spotting oaks and walnut. It may be found that this relatively inexpensive planting method is suitable for use with some species over a large area in these two states.

During the year the Station assisted one of the larger Forest Service nurseries in devising methods for selecting the spruce planting stock most likely to survive on cut-over and burned areas.

The great variety of tree species in the Station's territory attracts attention all over the world, and the absence of a commercial agency to provide specimens and reliable identification for some of the less well known and rarer species leads collectors to the Station for assistance. In most instances the Station is able to provide a few samples but of course can not furnish large quantities of wood, seed, or planting stock.

Forest Measurements

There are now 11 large pulp mills in the Station's territory. Most of these started operating within the past three years. They use approximately 1-1/2 million cords of wood each year and this new market for wood, especially in small sizes, has given tremendous impetus to raising wood as a crop. Farmers in the vicinity of pulp mills are attempting to decide whether or not this will be profitable. To assist in answering this question, the Station has computed yield tables showing how much wood may be expected on different site qualities at various ages. A simple method for determining site quality has been developed. In addition, the Station has worked out tables showing the cordwood volume of standing trees of different sizes and other methods of estimating quantity of pulpwood so that the timberland owner may determine approximately how much pulpwood he has on his land now and will have at any given time in the future.

In this region, where many tree species can be marketed for a variety of products, it is necessary to have some means of converting from one unit of measurement to another, as for example, from board feet for sawlogs to cubic feet for pulpwood or fuelwood. A study

made during the year has provided a series of these much-needed converting factors for hardwood species. One result of the study which has considerable practical importance is the discovery that a series of converting factors varying with log diameter must be used to obtain reasonably reliable results.

Silviculture

The Station's work in silvicultural research is aimed at providing answers to questions of how best to manage stands of timber in order to obtain the largest possible yield of the best quality timber. This work is made especially difficult because in this region a tremendous number of tree species grow in mixture but in different proportions so that two stands of timber seldom are alike.

The Station has three main classes of silvicultural studies: "cleanings" in young stands; thinnings (intermediate harvest cuttings) in middle-aged stands; and harvest cuttings in mature stands.

One of the troublesome problems confronting forest administrators in the region is the question of what to do with young stands which have come in after heavy cutting and repeated fires. These stands contain 20 or more merchantable species and an even larger number of "weed" species which compete severely with species of commercial value. About five years ago the C.C.C. began large-scale "cleaning" operations covering more than a million acres in the mountainous portion of the Station's territory. In the summer of 1938 the Station began a study to determine if these cleaning treatments have resulted in definite stand improvement or, if not, what changes in stand improvement methods are needed. It was found, for example, that present cleaning methods adequately release white oak but do not satisfactorily release red spruce. To obtain adequate release for red spruce, either taller trees must be selected as crop trees or a second cleaning will have to be made within 10 years after the initial release cutting. Similar information is being obtained for other species.

A small experiment in pruning white pine so as to obtain clear lumber has demonstrated that not more than 20 percent of the living whorls of young white pine trees should be removed if diameter growth is to be maintained.

During the year improvements in a tree classification for white oak were made. If further work shows this tree classification to be reliable, it will be extended to include other commercial species and will be an invaluable aid in improving present timber-marking practices for harvesting old-growth mountain hardwoods.

It was found during the year that mature stands of mountain hardwoods should not be opened up beyond a certain point if considerable hemlock is present in the stand. The results of this study already are

influencing marking practice on the national forests of the region and will prevent excessive loss of hemlock through blow-down.

The Station found also that opening up second-growth stands of sawtimber-size cove hardwoods beyond a certain point results in the development of so many epicormic sprouts just below the crown that the clear stem length of residual yellow poplar trees is reduced by at least one log.

To find the best method of managing loblolly pine for pulpwood, the Station started in 1938 a series of tests involving six diffent types of cutting. Two of these are applications of the cutting practices adopted by pulpwood associations. The remaining four are variations to determine the efficiency of other methods both in reproducing new stands from seed tree cuttings and in maintaining high yields from thinned stands. It is expected that preliminary results from the seed tree tests can be made available within two years and from the thinning tests in five years. The results of this experiment have immediate practical application, particularly in farm woodlots.

A study of cut-over areas in mountain forest types was nearly completed during the year. Results of this analysis of cutting methods should indicate changes needed in timber-marking practices and also will yield definite information on the present condition of cut-over areas in these forest types. A report will be issued early in 1939.

One of the most difficult problems confronting the Station is to devise some method of predicting forest growth in all-aged stands of mixed species. Thus far no successful yield table for this forest condition has been devised. After a preliminary survey it was concluded that the best way to obtain this information is by long-time observations on permanent sample plots in representative forest stands. The Station has about 3,000 plots on which this basic information is being obtained. One result of the study developed during the year was a promising method for mortality determinations for certain hardwood species.

An ever-increasing amount of time is devoted by silviculture staff members to answering questions on specific forest management problems. Many of these questions require field consultation. During 1938 Station technicians spent considerable time helping public and private agencies in designing experiments aimed at providing answers to local problems encountered by these agencies. For example, a lumber company obtained assistance from the Station in laying out an experiment to discover the best method of thinning stands of bottomland hardwoods. The state foresters and state extension foresters are turning to the Station for assistance and advice on forestry problems. Likewise, the newer Federal agencies, such as the Tennessee Valley Authority and Soil Conservation Service, are asking for help on forestry problems encountered in management of forest lands under their jurisdiction.

These questions concerning proper forest management cover a wide variety of subjects relating to timber growth -- a recent inquiry

asked for advice on whether or not it would be financially profitable to fertilize (as cultivated crops are fertilized) forest stands used for growing crops of pulpwood. The proper management of farm woodlands, particularly for pulpwood, is the subject of many inquiries recently received. Requests for local volume and yield tables for specific purposes -- such as for raising loblolly pine on pulpwood rotations -- continue to come to the Station in steadily increasing numbers.

Several technical reviews of timber management plans have been made during the year. Staff members also have met with national forest administrators in the field to assist in determining which species, sizes of trees, etc., to select for cutting in national forest timber sales. The Station maintains a lively interest in the objectives of various nature societies and assists these organizations in preserving stands of timber in undisturbed natural condition for scientific study. Conferences with the teaching staffs of forestry schools in the Station's territory provide these men with up-to-date information on forestry techniques; staff members of the Station also are available for occasional lectures to forestry school students.

Fire Control Research

Forest fires are still a major obstacle to successful forestry practice almost everywhere in the Station's territory, where each year 40,000 fires burn 7-1/2 million acres and cause nearly 9 million dollars' worth of damage to tree crops alone. In addition, fires cause tremendous losses to watersheds, to fish and wild game, destroy opportunities for forest recreation, and damage other valuable forest assets which are difficult to measure in terms of dollars and cents. Fifty-five percent of the area needing organized fire protection does not have it. Eleven percent of the unprotected area burns over every year. Despite notable advances during the last 10 years in preventing and suppressing forest fires in this region, much still remains to be done.

About 98 percent of the forest fires in the region are man-caused -- accidentally, through ignorance or indifference to the damaging effect of forest fires, or actually are incendiary. The Station has not been able to work directly on the fire prevention problem but proposes to do so as soon as equally pressing work now under way is completed.

In this region the chances of fires starting, the rapidity of their spread, and the difficulty of control vary by season of the year and also vary tremendously by days within the fire seasons. A difficulty faced by forest administrators is to know in advance what the fire danger willbe so that preparations may be made to combat fires. Guessing has proved to be expensive. The Station has devised a system of fire danger measurement that not only indicates degree of present fire danger and difficulty of control but gives a 24-hour forecast of danger so that fire suppression forces can be organized in time to hold fire losses to a minimum. A distinct advantage of the system is that estimates of fire danger in widely separated parts of the region and by different individuals

are strictly comparable, thus permitting fire control executives to base decisions on accurate information rather than guesses expressed in such generalized terms as "bad", "not so good", etc. This system of fire danger measurement is now in operation on most of the national forests in eastern United States. With possible modifications it should be applicable also to forest lands outside the national forests.

Another major difficulty experienced by forestry officials is the enormous variation in individual appraisals of forest fire damage and the difficulty of measuring damage to intangible values such as recreation and watersheds. The Station is now attempting to place these estimates on a more accurate and comparable basis, such as has already been done with estimates of fire danger. Considerable progress was made during the past year in developing a formula for appraising fire damage in hardwood stands. Work has not yet gone far enough, however, to justify issuance of a report.

Most of the Station's fire studies have been restricted to the national forests. The work has now gone far enough on these lands to permit expansion to privately owned lands outside the national forests. This step will be taken during the coming year and is an important one because it will mean direct assistance to state and private foresters responsible for possibly 90 percent of the total fire control job of the region.

The Station helped substantially in devising fire hazard reduction measures for the New England hurricane area and assisted in planning a system of fire danger measurement to help safeguard that region from disastrous forest fires.

WORK OF COOPERATING AGENCIES

Research in forest pathology and forest entomology is done cooperatively, but under separate appropriations, by the Bureau of Plant Industry and the Bureau of Entomology and Plant Quarantine, also of the U. S. Department of Agriculture.

Forest Pathology

In the appraisal of fire damage and the prediction of losses from fire, cull following basal wounding is one of the chief factors. Two years' investigation of this phase has led to the development of a statistical mechanism by which cull following fire can be predicted for Appalachian oaks. If the number of trees wounded and the widths of the wound are determined after a fire, the cull that will result in any given number of years can be estimated.

The rate of increase in volume of butt rot has been found not to be constant, but to diminish as time passes until after a certain number of years there is no further increase in butt cull. The number of years after which the volume of butt cull remains constant depends largely upon the original size of the wound. The cull that develops from wounds as narrow as 5 inches culminates at about 30 years, while that from wounds 24 inches wide usually does not reach its maximum until about 100 years. There is very high variability in the volume of cull that develops in different trees behind wounds of the same size on the same species, due largely to the species of fungi that become established behind the wounds. For this reason attempts should not be made to predict cull for single trees.

The curves that have been prepared should tend to standardize the prediction of cull following fire, eliminating personal judgment. They will probably prove equally useful both in fire damage appraisal and in determining salvage policy. Information on the other phases of fire damage obtained at this Station indicate that losses from cull will prove to be as important from the monetary standpoint as mortality following average fires.

The results of five years' investigation of basal decay in oak sprouts were brought together and submitted as a U.S.D.A. technical bulletin entitled "Butt Rot in Unburned Sprout Oak Stands". This work, which was based upon the dissection of all oaks on 1/4 or 1/5-acre unburned plots, ranging from 15 to 90 years old, scattered through the East and Middle West, brought out that about one-fourth of the unscarred second-growth oak trees are butt-rotted and that in about 90 percent of these cases the decay developed in the parent stumps and spread into the new sprouts. This condition was particularly prevalent where oaks had been grown on short rotations for fuel, charcoal, mine props, or distillation wood. The average height of decay in the butt-rotted trees was about 3 feet, and in most cases the rot was still developing actively when the trees were cut.

Sprouts that arose at or below ground level developed little decay, while those that originated high on the parent stumps usually became decayed through the transmission of rot from stump to sprout. Where fire preceded the establishment of a sprout stand the cambium and latent buds above ground were usually killed, thereby forcing sprout regeneration from buds at or below ground level, and thus conditions unfavorable for infection from the parent stumps were created.

One fairly reliable indication of butt rot in oak sprouts was found to be the presence of large basal wounds that resulted from the rotting away of the parent stumps. Parts of the stumps could often be seen projecting from the wounds. Sprouts that obviously arose high on parents stumps proved also to be poor risks, but the height of origin can be determined only in young trees. Multiple sprout groups were more frequently decayed than single stems.

A considerable amount of new fundamental information was obtained that has led to a clearer understanding of the development of sprout trees and the factors influencing their liability to decay. These include the discovery that the vast majority of oak sprouts arise from dormant rather than adventitious buds, that sprouts utilize the root systems of the parent trees rather than form independent systems, that the transmission of decay from stump to sprout depends upon the formation of heartwood at the point of union, and that all but a small part of the butt rot of this type is caused by a single fungus, Stereum gausapatum, about which little had hitherto been known.

These findings are of major importance in the management of the vast areas of second-growth oaks through the East and Middle West. They show that much of this young oak that appears sound on the outside and is free from fire wounds is decaying rapidly within. They also suggest means by which this butt rot hazard can be held to a minimum, through cleanings favoring sprouts of low origin, and the early elimination of high-risk trees in stands destined to produce sawtimber.

An investigation of the life history and control of the hemlock twig rust, caused by Melampsora farlowii, demonstrated that infestation takes place in the new foliage between the time the buds burst and the middle of June in Western North Carolina. The sources of inoculum are the overwintered telia in the twigs killed the preceding year. Effective control was obtained by spraying with lime-sulphur once a week during May.

Additional projects upon which progress has been made during the year include the vascular wilt of the mimosa tree, the pathological effects of increment boring, the recovery of yellow poplar from Nectria cankers, silvicultural methods to reduce the butt rot hazard in young sprout oak stands, and decay in stacked pulpwood.

A major feature of the year's work was the educational and advisory service to the C.C.C. Illustrated lectures on tree diseases

were given to 49 C.C.C. camps in the Station's territory. Past timber stand improvement work was examined to determine how well pathology recommendations were followed, and to note the effects of the work from the standpoint of subsequent damage and disease.

Forest Entomology

Further investigations during 1938 indicate rather conclusively that the introduction of certain water-soluble salts into living and freshly felled trees and into freshly cut posts and poles makes some of the non-durable hardwoods and softwoods resistant to damage by insects and decays. Methods have been developed whereby the treatments can be made by the layman with little expense for equipment and chemicals. Thus, these results may be of inestimable value to farmers and others interested in the practical use of non-durable woods for fences, rural power lines, rustic construction, and the like. The procedures of chemical injection investigated at the Asheville Station have aroused widespread interest, especially in the eastern states. Some of these states began independent studies in 1938 primarily to solve problems specific to these states.

Chemical injection studies have been carried on in a continued investigation of the control of bark beetles and other tree-killing insects. Along with the distribution studies of promising control chemicals, quantitative analyses by this Station have aided materially the chemical injection work of the forest insect laboratories at Coeur d'Alene, Idaho, and Berkeley, California.

Tests of chemical sprays to provide effective, cheap and simple means for the control of bark beetles and wood borers already give promise (1) of a practical control of the southern pine beetle with a consequent decrease in timber value losses caused by staining fungi introduced by bark beetles, and (2) of an effective means of saving trees of aesthetic values by killing the attacking insects without materially harming the trees.

An investigation to determine the relationship between starch content of sap hardwood and the attack and damage by Lyctus powder-post beetles is being carried on in conjunction with a study of hardwood seasoning and starch content depletion. The results may be of tremendous concern to marketers of hardwoods. Thus far the infestation tests indicate that there is a direct correlation between amount of starch in the wood and the damage resulting. Time of the year of cutting and seasoning procedures show that starch content in sap hardwood varies from one month to the other and that starch content can be reduced by methods of seasoning.

Although intensive investigations of white grub (Phyllophaga) control were not carried on during 1938, the procedure for control as recommended by this Station following several previous years of

investigation proved of value this past year in preventing a greater amount of seedling destruction than occurred in certain heavily infested forest nurseries.

Studies on control of one of the most destructive forest product insects, subterranean termites, were continued. Numerous infested buildings were treated with test chemicals, either by this Station or by the building owners following recommendations by this Station. Examinations of treatments made by commercial eradication concerns were made; and examinations of treatments put in during 1937 and earlier by this Station, by building owners, and by commercial concerns, were made also. Although prevention of termite infestation is primarily a matter of proper construction, there are and apparently will continue to be constructions made favorable or even inviting to termite attack and damage. Thus, control by simple and relatively inexpensive means must be found for use where structural changes cannot or need not be made because of the costs.

The insect that caused a considerable loss of red cedar seedlings in a forest tree nursery in Tennessee was found and determined as Hylemyia cilicrura. Tests for control gave very satisfactory results. However, inasmuch as there is a direct relationship between the abundance of this pest and the kind of fertilizers used in the beds, prevention of infestation will most probably depend on a change in the type of fertilizers used.

An intensive investigation of the insects found attacking persimmon and the relationship of these insects to the now very prevalent persimmon wilt disease in the Southeast were carried on. Of the numerous species of insects that attack persimmon, only two, Xylobiops basilare and Oncideres cingulatus, were abundant enough to be of consequence in spreading the disease. Some positive cultures of the wilt disease fungus were made. These appear to tie these two insects directly in with the distribution of the disease.

WHAT THE STATION NEEDS TO GIVE BETTER PUBLIC SERVICE

Although the staff of the Appalachian Forest Experiment Station has been expanded several times, it still has not been increased fast enough to keep pace with the demands on the Station for technical information and advice. Forestry administration has grown much faster than its research service.

To appreciate this, it is necessary only to think of the astonishing increase in forestry activities of all kinds in the past eight or ten years. Where formerly forest tree nurseries purchased seed in lots of a few pounds, they now deal with tons; fire lookout towers dot the countryside; there are now millions of acres in public forests; construction of hydroelectric power plants in forested areas has been followed by rayon mills; the big influx of paper mills began in 1935. New agencies, such as the Tennessee Valley Authority, Soil Conservation Service, and others dealing directly and indirectly with management of forest properties have been created. Land-use planning boards have begun to realize that nearly two-thirds of the total area of the region is forested and proper management of these lands can be a powerful aid in social and economic rehabilitation. All of these developments have thrust new responsibilities, extra loads, on the Station. It would be satisfying to say that the Station is meeting these increased needs adequately -- but it would not be true.

Research in certain fields has been seriously curtailed because so much time has been spent on the very necessary job of giving advice and technical assistance to those confronted with management of forest properties. Additional staff members should be provided to offset the time of those engaged more and more in providing technical assistance to forest administrators. The situation is especially critical in silviculture, fire control, and watershed management.

At the present rate of progress the Forest Survey of the region can not be completed in less than 10 years. With the present wholly inadequate staff, it may take five years to complete the survey in Virginia, where work is beginning in 1939. It will be five years before a start can be made in evaluating the forestry situation in West Virginia and perhaps 10 years before similar work can be started in Kentucky and Tennessee.

The small staff engaged in forest fire research has been adequate to meet the needs of the national forests, but these represent only a small part of the total forested area of the region. It will be impossible for the Station to discharge its obligations to the national forests and at the same time do very much to aid fire control activities outside the national forests unless the present staff is at least doubled.

Silvicultural research leading to effective forest management practices in coastal plain pine and hardwood forests can not be carried on

with the present staff. Such studies are urgently needed in that part of the Station's territory.

The Station's two cooperating agencies, forest pathology and forest entomology, are insufficiently financed to work on many urgent problems and to handle the large volume of service calls they now receive.

Research in watershed management must be expanded if the Station is to provide factual data for efficient administration of forest and wild land for the production of maximum quality and quantity of usable water. Technics of watershed improvement must be developed and demonstrated. Present resources have permitted the Station to make only a beginning in determining essential facts of watershed management. The destiny of industrial and municipal development on the upper Piedmont will be determined largely by an abundant supply of usable surface water, most of which comes from the national forests. It is imperative that the Forest Service be equipped with sound knowledge to meet its responsibility.

Research on the economics of forest management, forest fire control, and watershed protection will be a wise investment because it will insure efficient expenditures of public funds. The Station has no funds for such work.

Another new field of work for which funds should be provided is forest products or forest utilization research. If the Station could find new uses for forest products, particularly products which would utilize small sizes of trees and species at present considered commercially unprofitable, it would lead to the development of small industries throughout the region and thus greatly aid social rehabilitation in many places. Moreover, from a silvicultural standpoint many forest stands such as those in the Piedmont, where scrub hardwoods apparently are replacing marketable pine, probably can be returned to more profitable production only by developing uses for small-size material and for so-called inferior species. Products research, as much as silvicultural research, may prove to be the key to solving the puzzling problem of what to do with the deteriorated forest stands so prevalent in this region.

EXPERIMENTAL FORESTS

A part of the work of the Station is concentrated on experimental forests of a few thousand acres located in representative areas in the principal forest types of the region. This procedure insures permanency to long-time experiments, provides convenient work centers from which surrounding territory can be reached for short-time experiments covering a wide area, and facilitates demonstration of research results. The present (incomplete) system of experimental forests is:

Bent Creek -- In the Pisgah National Forest 10 miles south of Asheville, North Carolina. Area 5,200 acres. Representative of cut-over and generally rather run-down forests of mountain hardwoods and pines at altitudes from 2,000 to 3,000 feet. Studies now in progress are forest management, fire damage, forest influences, pathology, and entomology.

Coweeta -- In the Nantahala National Forest 8 miles south of Franklin, North Carolina. Area 4,300 acres. Contains a great variety of forest type and condition classes but was severely cut over and primarily is a second-growth forest. This experimental forest is in the 80-inch rainfall belt and is now devoted chiefly to forest influences investigations.

Santee -- In the Francis Marion National Forest, about 50 miles north of Charleston, South Carolina. Area 5,000 acres. Typical of longleaf pine, loblolly pine, and other coastal plain forest types in South Carolina. In process of establishment. Investigations are contemplated in forest management, fire control, and entomology.

Fernow -- In the Monongahela National Forest at Parsons, West Virginia. Area 3,640 acres. Representative of second-growth Appalachian hardwood and northern hardwood forest types. Research here is now mainly fire control and silvicultural studies.

Lee -- About 15 miles northwest of Farmville, Virginia. Area 2,600 acres. Second-growth Piedmont Plateau forests on abandoned fields, many of which are still non-forested. In process of establishment. Studies in silviculture, forest planting, and fire control are contemplated.

Toccoa -- In the Chattahoochee National Forest 12 miles from Blairsville, Georgia. Area 3,725 acres. Appalachian hardwoods in southern part of their range. Silvicultural and fire control investigations.

Copper Basin -- (Not an experimental forest but used as a field work center.) Near Copperhill, Tennessee. An area of complete and partial forest denudation resulting from copper-smelter fumes. Forest influence studies.

P E R S O N N E L

General Administration

R. E. McArdle	Director
R. M. Nelson	Senior Silviculturist
C. W. Mills	Jr. Administrative Assistant
G. M. Foltz	Senior Clerk
J. Laxton	Senior Clerk
W. A. Nesbitt	Junior Forester
E. S. Curtis	Clerk-Stenographer
M. P. Gudger	Senior Stenographer
*M. V. Brandt	Asst. Clerk-Stenographer
I. M. Powell	Junior Stenographer
D. Brown	Laborer

Forest Management Research

L. I. Barrett	Senior Silviculturist
E. H. Frothingham	Senior Silviculturist
J. H. Buell	Associate Silviculturist
G. M. Jemison	Associate Forester
L. E. Chaiken	Assistant Forester
N. E. Hawes	Assistant Forester
L. S. Minckler	Junior Forester
A. A. Downs	Junior Forester
G. M. Byram	Junior Meteorologist
W. E. McQuilkin	Jr. Forest Ecologist
*J. F. Renshaw	Junior Forester
F. R. Lynn	Asst. Clerk-Stenographer

Forest Survey

E. V. Roberts	Senior Forester
E. B. Faulks	Assoc. Forest Economist
W. T. Hicks	Associate Economist
G. E. Morrill	Assoc. Forest Economist
T. C. Evans	Assistant Forester

Forest Influences

C. R. Hursh	Senior Forest Ecologist
R. A. Hertzler	Assistant to Technician
H. C. Creasman	Assistant to Technician

*Transferred during 1938.

Flood Control Surveys

H. J. Loughead	Associate Conservationist
S. D. Beichler	Associate Forester
*L. K. Hill	Assoc. Civil Engineer
M. M. Bryan	Assistant Forester
J. E. Keefus	Junior Forester
R. D. Williams	Junior Forester
H. Thornton	Asst. Clerk-Stenographer
H. K. Steiner	Jr. Statistical Clerk
M. Turnipseed	Jr. Statistical Clerk
I. Willoughby	Jr. Statistical Clerk

C O O P E R A T O R S

Bureau of Entomology and Plant Quarantine
Division of Forest Insect Investigations

B. H. Wilford	Associate Entomologist
W. L. Baker	Assistant Entomologist
R. J. Kowal	Junior Entomologist
A. F. Powell	Asst. Clerk-Stenographer

Bureau of Plant Industry
Division of Forest Pathology

G. H. Hepting	Associate Pathologist
E. R. Roth	Junior Pathologist

*Transferred during 1938.

The above list does not include technical and clerical employees paid from emergency funds.

PUBLICATIONS
BY
MEMBERS OF THE STAFF (INCLUDING COOPERATORS)

January 1, 1938 - December 31, 1938

BURGESS, A. F. and W. L. BAKER	The gypsy and brown-tail moths and their control. U.S.D.A. Circ. 464. March 1938.
BYRAM, GEORGE H.	A note on the calibration of duff hygrometers. Jour. of Forestry 36: 605-606. June, 1938.
EATON, CHARLES B.	An injector for forcing liquids into the soil. Bur. of Ent. and Plant Quarantine Brief ET-127. Aug. 1938.
HEPTING, GEORGE H. and A. D. CHAPMAN	Losses from heart rot in two shortleaf and loblolly pine stands. Jour. of Forestry 36: 1193-1201. Dec. 1938.
HERTZLER, RICHARD A.	Determination of a formula for the 120-degree V-notch weir. Civil Engineering, Nov. 1938.
HURSH, C. R. and C. A. CONNAUGHTON	Effects of forests upon local climate. Jour. of Forestry 36: 864-866. Sept. 1938.
MacKINNEY, A. L. and C. F. KORSTIAN	Loblolly pine seed dispersal. Jour. of Forestry 36: 465-468. May, 1938.
MacKINNEY, A. L. and W. E. McQUILKIN	Methods of stratification for loblolly pine seeds. Jour. of Forestry 36: 1123-1127. Nov. 1938.
MINCKLER, LEON S.	Review - Water utilization by trees with special reference to the economic forest species of the north temperate zone, by Oran Raber, U.S.D.A. misc. pub. 257. Jour. of Forestry 36: 535. May, 1938.
MUNGER, THORNTON T. and LEONARD I. BARRETT	The march of silviculture. Jour. of Forestry 36: 837-840. Sept. 1938.

MIMEOGRAPHED NOTES AND REPORTS

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BUELL, J. H.	List of specimens in the herbarium. App. For. Exp. Sta. tech. note no. 30. June, 1938.
HILL, L. K. and K. A. MacKICHAN	Manual for the compilation of hydrological data for small drainage areas. Mimeo. June, 1938.
HURSH, C. R.	Mulching for roadbank fixation. App. For. Exp. Sta. tech. note no. 31. Sept. 1938.
JEMISON, GEORGE M.	The Appalachian forest fire danger meter. App. For. Exp. Sta. tech. note no. 26. Jan. 1938.
_____	The Appalachian scale of wind velocity. App. For. Exp. Sta. tech. note no. 29. April, 1938.
_____	The measurement of forest fire in the mountains of eastern United States. Processed. Oct. 1938.
_____	Occurrence, behavior, and cost of fires in relation to forest fire danger. App. For. Exp. Sta. tech. note no. 27. Feb. 1938.
_____	Relation of Byram haze meter reading to safe visibility distance of smoke from an eighth-acre fire. App. For. Exp. Sta. tech. note no. 28. Feb. 1938.

RS - AP
M-1 (Ci)

January 1, 1939

PROJECT STATUS SHEET

Stand Improvement in Mountain Types

Field division: Forest management research.
Work project: Silviculture.
Line project: Stand improvement in mountain types.
Purpose: To develop standards for cultural operations that will maintain and improve the growth rate and quality of established desirable components of juvenile stands of mixed species.
Review of past work: Past work in which the forest stands were the unit of observation indicates that although cultural treatments resulted in improved conditions, the findings could not readily be translated into terms of definite operation standards useful in practical application. Because individual crop trees are the basic unit of treatment, the study method was changed to large-scale tests of individual trees in stands 10-25 years old. Tests of four methods of weeding three of the most valuable hardwood species have been completed. Less intensive work has been done on three additional species.

Additional stand improvement work has been limited to studies of (a) the influence of pruning various portions of the live crown on the subsequent growth of white pine, and (b) the results of liberation treatments on the growth rate of reproduction of this species.

Delayed response to treatment was found to occur with young crop trees of white oak and white pine. By the fifth season, however, the average height growth made during the five years by untreated white pines was only 75 percent of that made by those treated.

Sugar maple responded to crop tree cleanings during the first growing season, treated trees showing nearly three times as much d.b.h. increment as check trees. Differences in the influences of various kinds of crop tree cleanings did not become apparent during the first season, however.

Accomplishments during the past year: Record of growth for two years since pruning has shown that not over 15-20 percent of the living whorls of young white pine should be removed if diameter growth is to be maintained.

Studies made in stands treated five years ago by the C.C.C. have shown that white oak crop trees grew 82 percent faster in d.b.h. and 26 percent faster in height and that red spruce grew 94 percent faster in d.b.h. and 172 percent faster in height than during a similar period before treatment. For white oak, 75 percent of the crop trees will still be dominant at the end of 10 years, but only 45 percent of the spruce will still be dominant. The comparative failure of red spruce to retain dominance will be due in large part to the low initial height of the crop trees, which made it impossible for them to keep ahead of rapidly growing sprouts arising from cuttings made during original treatment.

Plans for next year: No new work will be started. To be continued are (a) surveys of five-year-old seedlings to improve present methods by evaluating results of past work, (b) cleaning studies in young

(Over)

hardwoods, (c) pruning studies in white pine, and (d) liberation studies in white pine.

Date of completion: Studies of past work by C.C.C. will be completed in 1939. Determination of best cleaning methods for maintenance or improvement of growth rate of young hardwood crop trees to be completed in 1943. The methods best suited to production of high-quality wood will probably not be determined until 1948. Definite conclusions regarding the influence of tree pruning on subsequent growth of white pine will be available by 1940.

Assignment: J. H. Buell.

RS - AP
M-1 (Ci)

January 1, 1939

PROJECT STATUS SHEET

Intermediate Harvest Cuttings in Mountain Types

Field division: Forest management research
Work project: Silviculture.
Line project: Intermediate harvest cuttings in mountain types.
Purpose: To develop for second-growth hardwood stands beyond the juvenile stage standards of cultural operations that will maintain or benefit growth rate and composition and produce a merchantable yield of small-dimension products.
Review of past work: Insufficient experimental cuttings and lack of markets for small products have made it impossible to conduct the research on an adequate scale. Past work has demonstrated the necessity for maintaining a secondary stand of carefully chosen "trainers" to provide the competition necessary for maintenance of quality increment.

Cost studies of manufacturing oak cordwood from improvement cuttings have shown that costs are most closely correlated with skidding distances and crown ratios of cut trees. Costs have been further analyzed to show their variation with changes in timber stand conditions and those conditions which are marginal.

Accomplishments during past year: Analysis of the oak cordwood cost production study was completed. Tests of various types of thinning in second-growth stands of cove hardwoods were begun on the Fernow Experimental Forest. Cuttings will require the removal of three types of products: fuelwood from sound and rotten culls; sawlogs from scattered residual trees left in previous logging; and the major crop, pulpwood. Fuelwood removal is under way, and the sawlog sale is imminent.
Plans for next year: Tests of thinnings in second-growth cove hardwoods will be continued. Sales of pulpwood will, if possible, be made in 1939 to complete establishment of a series of 24 plots on the Fernow Experimental Forest.
Date of completion: Results from the new work in thinnings and improvement cuttings to be established during 1939 will be available late in 1939 insofar as the yield of products is concerned. Results of the effect of thinning methods on increment will be available about 1944.
Assignment: J. H. Buell.

RS - AP
M-1 (Cr)

January 1, 1939

PROJECT STATUS SHEET

Harvest Cuttings in Mountain Types

Field division: Forest management research.
Work project: Silviculture.
Line project: Harvest cuttings in mountain types.
Purpose: To determine for mature timber types the silvicultural systems that will result in abundant desirable reproduction and produce the greatest sustained increment of high quality products.
Review of past work: Appalachian hardwood types can be reproduced and pertuated under either clear cutting with seed trees or by some form of partial or selection cutting. Past work has shown the dangers of quality deterioration in residual stands under partial cutting. Further research is needed to determine which of these systems will produce the greatest sustained increment of quality products. Because of the difficulty of determining "poor risk" trees under the system of partial cutting, an exploratory study of tree classification for hardwoods has been made with white oak being used as the sample species.
Accomplishments of the past year: Improvements in the tree classification for white oak were made. . . . Observations made on four-year-old experimental cuttings in old-growth sawtimber stands showed excessive mortality of residual hemlock. This observation was checked on several timber sale areas and already has influenced marking practice for hemlock on one national forest. It also was found that leaving a residual stand of 40 percent of the merchantable trees on an area of 70-year-old cove hardwoods resulted in reducing the clear stem length of yellow poplar residual trees by about one log at the end of four years through development of epicormic sprouts.
Plans for next year: Reexamination of four selectively cut areas and analysis of data for these and two other areas already reexamined will be completed during 1939. Specific points to be covered are: (1) extent of mortality following cutting, (2) accelerated growth following cutting, (3) volume increment resulting from residual stands of varying volumes, and (4) clear stem length as influenced by stand density.
Date of completion: (1) Results covering the above four points will be issued in 1939. (2) Tests of influence of silvicultural system on sustained quality increment is a continuing long-time project, and preliminary results can not be expected before 1943.
Assignment: L. I. Barrett.

RS - AP
M-1 (Special Studies)
Cut-over Areas

January 1, 1939

PROJECT STATUS SHEET

Cut-over Area Analysis, Mountain Forests

Field division: Forest management research.
Work project: Silviculture.
Line project: Cut-over area analysis, mountain forests.
Purpose: An analysis of stand conditions following cuttings of different kinds and degrees in different forest types in the mountain region, including: quantity and growth-rate of reproduction, by species and origin; growth-rate, crown expansion, and significance of residual stand; composition of reproduction following death of chestnut; and related subjects.
Review of past work: Field work by Station (1927-1929) and national forest administrative staffs (1929 and later) resulted in about 350 tallies of cut-over areas. Additional field work done on Stony Fork (Pisgah) cultural treatment plots and on Mons, Virginia, chestnut replacement plots to determine effect of crown expansion on reproduction.
Accomplishments during past year: Except for growth-rate and crown expansion, the analysis was completed, providing a possible means for appraising any cut-over area less than 20 years old in terms of (a) quantity and quality of residual stand and reproduction, and (b) indicated improvement measures.
Plans for next year: Results so far obtained to be prepared for publication, including effects of cutting on composition of the stand, trends in relations of size and quality classes in residual stand and in different components of the reproduction, influence of severity of cutting, and the method of appraisal indicated under preceding heading.
Date of completion: 1939.
Assignment: E. H. Frothingham.

RS - AP
M-4 (Ci)

January 1, 1939

PROJECT STATUS SHEET

Intermediate Harvest Cuttings in Second-Growth Oak-Pine

Field division: Forest management research.
Work project: Silviculture.
Line project: Intermediate cuttings in second-growth oak-pine.
Purpose: To determine the most efficient methods of maintaining and improving the desirable components of juvenile stands, and to develop methods of thinning for both stand improvement and the production of small-dimension products in second-growth stands beyond the juvenile stage.
Review of past work: New project in 1938.
Accomplishments during past year: Tests of six types of cuttings in loblolly pine stands of pulpwood size were started. Three of these tests are designed to determine the reproductive ability of various numbers of seed trees where the final purpose of management is pulpwood production. The other three treatments are designed to determine the yield under different severities of thinning when the ultimate purpose of management is to produce sawtimber with other products secondary. Five series of plots in three states were selected and preliminary measurements made with a full set of six treatments at each location. Cutting was completed at one location.
Plans for next year: Cutting on at least two series of plots will be done if possible.
Date of completion: Project continuous. First results from seed tree cuttings will be available by 1941. First results from thinnings by 1943.
Assignment: Norman E. Hawes.

RS - AP
M-4 (Cr)

January 1, 1939

PROJECT STATUS SHEET

Harvest Cuttings in Mature Oak-Pine

Field division: Forest management research.
Work project: Silviculture.
Line project: Harvest cuttings.
Purpose: To determine methods of harvesting mature timber that will produce the greatest sustained increment of quality material.
Review of past work: Thirty-two permanent sample plots were established in 1936 in a stand of mature shortleaf pine and hardwoods to test the influence of different kinds of cutting upon the establishment of desirable reproduction and increment of residual stand.
Accomplishments during past year: Maintenance of existing permanent plots.
Plans for next year: Reexamination of reproduction established on existing plots.
Date of completion: Results of cutting method upon reproduction establishment to be completed by 1940. First results of effect of cutting upon increment of residual stand will be available by 1942.
Assignment: L. E. Chaiken, Norman E. Hawes.

RS - AP
M-4 (R)

January 1, 1939

PROJECT STATUS SHEET

Reforestation of Abandoned Farm Land in the Piedmont Region

Field division: Forest management research.
Work project: Regeneration.
Line project: Reforestation of abandoned farm land in the Piedmont region.
Purpose: To determine what factors affect natural regeneration of abandoned agricultural land. To devise efficient methods for artificially reforesting abandoned agricultural lands.
Review of past work: A preliminary study of the factors affecting natural regeneration on abandoned fields showed that condition and extent of seed source were the most important factors. It was found that if an adequate seed source is present, 1,000 seedlings pere acre will be established within five chains and 500 seedlings per acre within seven chains of the seed source.

Standards for the proper storage of loblolly pine seed were determined. These require that the seed be stratified for three months in moist media at temperatures of 32 to 40 degrees Fahrenheit.

Accomplishments during past year: An intensive study of different kinds of treatment of seed spots for both spring and fall sowing under several general conditions of site in the Piedmont region was begun. Fall sowing was completed on schedule.
Plans for next year: Complete spring sowing and determine the site factors associated with seedling mortality.
Date of completion: 1941.
Assignment: Wm. E. McQuilkin and A. A. Downs.

RS - AP
Fp

January 1, 1939

PROJECT STATUS SHEET

Artificial Regeneration in Mountain Types

Field division: Forest management research.
Work project: Regeneration.
Line project: Artificial regeneration in mountain types.
Purpose: To determine the tree species best adapted to planting on (a) abandoned agricultural lands of the Cumberland foothills of Kentucky and Tennessee, and (b) cut-over spruce lands at high elevations in the Appalachian Mountains.
Review of past work: Definitely organized planting research has been under way for only one year. Work before 1938 included: The plantations on the Biltmore Estate near Asheville, N. C., were described in U.S.D.A. Miscellaneous Publication No. 61 in 1930. A few small test plantations of coniferous species were made in the cut-over spruce type on Mt. Mitchell at various times between 1923 and 1931.
Accomplishments during past year: In cooperation with the Tennessee Valley Authority, eight experiments dealing with planting problems on abandoned land of the Appalachian Valley of Kentucky and Tennessee were started. In eight experimental plantings located near Norris, Tennessee, 390 plots were established (about half the total number of plots needed). First-year survival records of these plantations show excellent survival obtained from seed spotting oaks and walnut. In none of the eight experiments did first-season survival fall below 89.7 percent.

A brief study was made of methods used to measure survival of trees in plantations. It was found that the customary staked row procedure for evaluating plantation success is expensive and frequently is not accurate enough for present needs. An improved procedure designated the "block line" method was developed giving more accurate results at no increased cost.

A reconnaissance of the spruce type with particular attention to established plantations on cut-over lands showed that early plantation success was not significantly correlated with soil type unless the soil is very rocky or poorly drained. The important factor in plantation success in this type was found to be density of herbaceous vegetation. The results obtained in this preliminary study were used to design planting experiments in the spruce type.

Plans for next year: (1) The experimental plantations near Norris, Tennessee, to be completed during February, 1939. (2) First-year survival records for these plantations to be completed after the 1939 growing season. (3) Preparations for establishment of planting experiments in the spruce type.
Date of completion: Project as a whole continuous. First results from work at Norris, Tennessee, will be available by 1940. First results from experimental spruce plantations available about 1941.
Assignment: L. S. Minckler.

RS - AP
M-3

January 1, 1939

PROJECT STATUS SHEET

Management of Southern Pines on the Coastal Plain

Field division: Forest management research.

Work project: Silviculture.

Line project: Harvest cuttings (Cr), intermediate cuttings (Ci), growth, yield, and mortality determinations (Gr), and regeneration (R).

Purpose: To study the growth, reproduction, and management of pines, particularly loblolly pine, and associated species, in the Middle Atlantic coastal region.

Review of past work: Fourteen permanent sample plots to test the results of various types of harvest cuttings have been established in partially cut stands of loblolly pine sawtimber in cooperation with private timber land owners. Reexamination of these plots has indicated considerable mortality in residual trees that had suffered only apparent minor damage at the time of logging.

Volume, growth, and yield tables for non-normal stands of loblolly pine have been completed.

Mortality in pine stands is being studied on 200 permanent sample plots in cooperation with the Samter National Forest.

Cost production data obtained in 1931 from a coastal plain saw mill were analyzed to determine the relationship between age of trees and lumber value. It was found that lumber cut from trees over 80 years of age was worth approximately $5.50 more per M than the lumber cut from trees under 40 years of age. The volume of the upper grades of lumber was 50 percent of the total volume cut from the older trees, whereas for those 40 years of age and under the upper grades comprised only about 13 percent of the total cut. This study is closed.

A plantation of 16,000 loblolly pine seedlings has been established to determine the influence of single parent characteristics upon the growth and survival of these seedlings.

Accomplishments during past year: The third annual reexamination of the loblolly pine one-parent heredity plantation was made.

Plans for next year: Work in coastal plain forests will be limited to maintenance of established experiments until funds for expanding the work in this sub-region become available.

Date of completion: Preliminary results on the loblolly pine one-parent heredity study will be published in 1941.

Assignment: L. I. Barrett, L. E. Chaiken, and Norman E. Hawes.

RS - AP
M-4 (Gr)

January 1, 1939

PROJECT STATUS SHEET

Growth and Yield of Piedmont Oak-Pine Types

Field division: Forest management research.

Work project: Mensuration.

Line project: Growth and yield of Piedmont oak-pine types.

Purpose: To determine the growth rate of stands of various densities and compositions and of individual trees having different characteristics and growing conditions.

Review of past work: Volume and non-normal yield tables for second-growth loblolly pine and Virginia pine were completed in 1937. A new form of yield equation was developed which simplifies the technique necessary to the preparation of non-normal yield tables. The possibilities of a tree classification for second-growth loblolly pine have been investigated.

Accomplishments during past year: Volume tables, yield tables, and converting factors for second-growth loblolly pine of pulpwood sizes were compiled for release in handbook form. Non-normal yield tables for second-growth shortleaf pine were practically completed.

Plans for next year: (1) Release of handbook on volume and yield of loblolly pine. (2) Completion of volume and yield tables for shortleaf pine and preparation of a handbook giving volume and yield data for Virginia and shortleaf pines.

Date of completion: Project as a whole is continuous. Volume and yield data for the three important pines of the Piedmont and Coastal sub-regions with particular reference to pulpwood will be completed during 1939. Extension of these tables to larger tree sizes associated with mature timber can not be started before 1940.

Assignment: L. E. Chaiken and J. H. Buell.

RS - AP
M-1 (Gr)

January 1, 1939

PROJECT STATUS SHEET

Growth, Mortality, and Yield in Mountain Hardwoods

Field division: Forest management research.

Work project: Mensuration.

Line project: Growth, mortality, and yield in mountain hardwoods.

Purpose: (1) To check and improve existing methods of determining forest growth in all-aged stands of mixed species; (2) to devise a method for estimating how long dead trees have been dead.

Review of past work: Growth predictions are the primary basis for sustained yield forest management plans. A review of past work shows that no really satisfactory method of predicting growth in all-aged stands of mixed species has been devised. The determination of tree mortality has proved to be a serious weakness common to all methods of growth prediction. It has been apparent for some time that the most satisfactory and accurate procedure for development of growth-predicting techniques and mortality determinations in all-aged stands of mixed species must be based on careful, long-time observations on permanent sample plots in representative forest areas.

Intensive work on this project was begun in 1933. Approximately 3,000 permanent plots were established in five different areas.

Accomplishments during past year: A study to determine which tree characteristics are most closely related to the elapsed time since death was completed. It was found for mountain hardwood species that the commonly used criterion -- the average diameter of broken limbs in the crown was poorly correlated with time since death and was very unreliable for periods over 8 years. For the southern yellow pines, however, this was found to be the best criterion. For hardwoods it was found that the best indication of the time elapsed since death can be obtained by estimating the percentage of bark remaining on the lower 5 feet of the tree bole.

Plans for next year: A technical note, "Criteria for Mortality Determinations in Appalachian Hardwoods", will be issued.

Date of completion: (1) Field examinations will be made at intervals until sufficient mortality has occurred to set up improved standard dead tree specifications for the important commercial species; completed probably in 1945.

(2) Preliminary results on the development of growth prediction techniques will be available in 1940; final results in 1950.

Assignment: L. I. Barrett.

RS - AP
Pf-1

January 1, 1939

PROJECT STATUS SHEET

Fire Control

Field division: Forest management research.
Work project: Forest fire protection.
Line project: Fire control.
Purpose: To develop methods for determining the standards of detection and speed and strength of attack, based upon different degrees of occurrence, visibility, fuel type, inflammability, and potential damage.
Review of past work: Major emphasis has been placed on detection planning, including the development of techniques for visible area mapping and lookout-point value compilations and the development of a haze meter for non-mountainous country. A three-year field study of visibility and weather measured at approximately 45 stations has reached the analysis stage. The Station has contributed to a regional fuel type classification by report analysis and study of going fires.
Accomplishments during past year: Final field tests of the Plains Haze Meter were made and a description of the instrument has been prepared for publication. Other reports on the theory and application of visibility measurement were completed and will form part of a major publication.
Plans for next year: Analysis of haze meter and weather records will be completed to show the relation between visibility distance and hour of day, season, geographical region, and weather.

Final analysis of fuel type data collected on fires during the past two years is planned.

A better eyesight test for lookout men is now being devised and will be perfected during the coming year. The device will enable a rating of the eyesight of lookout men to be expressed in terms of their ability to see smokes.

Although actual work may not be commenced, working plans will be prepared for the following studies: (1) relative visibility of standard smokes within the visual range, (2) smoke volume as related to fuel moisture, fuel type, and rate of spread, and (3) techniques for determining the value of stationary versus moving detectors.

Date of completion: Analysis of haze meter records - 1939. Eyesight test for lookout men - 1939. Analysis of fuel type data - 1939. Other visibility and detection studies - indefinite.
Assignment: G. M. Jemison and G. M. Byram.

RS - AP
Pf-2

January 1, 1939

PROJECT STATUS SHEET

Fire Behavior

Field division: Forest management research.
Work project: Forest fire protection.
Line project: Fire behavior.
Purpose: (1) To determine the fundamental laws of ignition and combustion and their application to forest fires and (2) to develop methods of measuring the temporary or fluctuating fire danger variables and of integrating them into numerical ratings so that (a) fire control officers may be able to determine when different types of prevention, detection, and suppression activities are justified, (b) fire prevention and control efficiency may be rated correctly, and (c) fire control may be financed on a sound basis.
Review of past work: Early studies included analyses of weather factors preceding or accompanying severe fires and preliminary investigations of fuel and weather relations. Recent emphasis has been given to study of principles and techniques of fire danger measurement.
Accomplishments during past year: A major revision of the Appalachian fire danger meter adapted this device to all eastern mountain forest conditions. The new meter is being tested at 90 stations on the national forests from New Hampshire to Georgia. In addition, plans have been made for adapting the danger measuring system to the forest conditions encountered in six New England states damaged by the September hurricane. A new feature of the danger meter permits 24-hour forecasts of fire danger class, thereby facilitating detection and suppression organization.

Fuel and weather data have been obtained at two stations in longleaf and loblolly types since September and will be used in the development of a fire danger meter for the Coastal Plain.

Extensive field tests of the fuel moisture indicator sticks and scales resulted in improvements in the latter device. It is now an instrument suitable for country-wide use in fuel moisture measurement.

Apparatus was designed and developed for studying the relation between fuel moisture equilibria and wind and solar radiation. Investigations, nearly complete, have added to knowledge of the fundamentals of combustion, and the importance of these factors as fire danger variables has been determined.

Construction of six fire-weather stations, paired by elevations (2300 feet, 2800 feet, and 3300 feet), one of each pair on a NW and one on a SE aspect, was completed and measurements of temperature, humidity, wind, and precipitation have been recorded. These, with the two additional control stations, will provide sufficient data at Bent Creek Experimental Forest to determine the effect of elevation and aspect on fire danger.

Plans for next year: It is planned to check the use of the new danger meter on all national forests and strengthen weaknesses that may develop. Extension of its use by state protective organizations will be encouraged.

(Over)

A danger meter applicable to the Piedmont and Coastal Plain will be developed.

The study of fire weather conditions as modified by elevation and aspect will be continued. It will be necessary to design a suitable fuel moisture reocrder for use in this study.

Date of completion: Check of fire danger meter and extension to state agencies - indefinite. Fire danger meter for Piedmont and Coastal Plain - 1939. Fuel moisture-weather relations by elevation and aspect - 1944.

Assignment: G. M. Jemison and G. M. Byram.

RS - AP
Pf-3

January 1, 1939

PROJECT STATUS SHEET

Fire Effects

Field division: Forest management research.
Work project: Forest fire protection.
Line project: Fire effects.
Purpose: To ascertain the effect of fire on standing timber, reproduction, other vegetation, and site in order to furnish information basic to (a) the formulation of sound fire prevention and control plans and policies, (b) the appraisal of fire damage, and (c) the determination of the value of fire as a silvicultural agent.
Review of past work: Past work has included extensive surveys of tree mortality, mortality and physical damage to vegetation on experimentally burned sample plots, and decay following fire wounding.
Accomplishments during past year: A summary of all available mortality data by fire intensity classes showed what types of fires and stands must yet be investigated.

A technique was developed for determining the statistical significance of changes in diameter growth rate following fire. Studies of the effect of basal wounding on the growth of white, scarlet and black oak, and yellow poplar were completed as well as investigations of the effect of crown browning on diameter growth of shortleaf pine.

The relation between cull in important hardwood species and wound width and age of wound was established in a cooperative study supervised by Forest Pathology.

Preliminary work on a technique for damage evaluation was undertaken. Consideration was given to mortality, growth, and cull following fire in this exploratory work.

Plans for next year: Fire effects work for the next year will consist primarily of development of an outline for damage appraisal in hardwoods. This means that additional mortality data must be obtained. Existing methods of classifying fire intensity will be improved for appraisal application. Additional data will be obtained and analyzed to show effect of fire on diameter growth.

Study of the relation of cull to fire wounding will be continued in cooperation with Forest Pathology.

Preliminary analysis of fire effects records for Coastal Plain plots will be made. Some of these plots have been burned annually for eight years.

Date of completion: Mortality and growth studies for mountain forests - 1941. Relation of cull to fire wounding - 1940. Preliminary damage appraisal technique - 1940. Effect of annual burning on growth and mortality of pine on the Coastal Plain - indefinite.
Assignment: G. M. Jemison.

RE - AP
Forest Survey

January 1, 1939

PROJECT STATUS SHEET

Forest Survey -- Inventory Phase

Field division: Forest Survey.
Work project: Survey of forest resources.
Line project: Inventory.
Purpose: To determine the extent, location, and condition of forest lands in the Station's territory and the quantity, kinds, quality, and availibility of timber now standing on these lands.
Review of past work: The Forest Survey organization was established at this Station in April, 1936, and field work was begun in July of the same year. By December, 1937, when the field organization was disbanded, all of South Carolina not previously covered by the Southern Station and all but the mountain unit of North Carolina had been completed.

The basic tables of area and volume were computed during 1937 for the South Carolina units, and tabulations were started on the North Carolina field data.

Accomplishments during past year: A small field crew was organized in June, 1938, to complete the inventory cruise of the mountain unit of North Carolina (5,393,000 acres). This work was completed in November and the field organization was again disbanded.

To December 31, 1938, the inventory survey had covered approximately 45 million acres and had completed the field work in North and South Carolina. Nearly 65 million acres in Virginia, West Virginia, Kentucky, and Tennessee remain to be completed.

During the year the basic tables of area and volume were compiled for the three eastern units in North Carolina and tabulations were begun for the mountain unit data.

Plans for next year: If funds permit, field work will be resumed in July. Present plans provide for completing the coastal unit of Virginia during the year and perhaps extending the work to the Piedmont units of that state.

The basic tables of area and volume will be completed for the mountain unit during the year, making state totals available.

Date of completion: Indefinite.
Assignment: E. V. Roberts, G. E. Morrill, T. C. Evans.

RE - AP
Forest Survey

January 1, 1939

PROJECT STATUS SHEET

Forest Survey -- Growth and Yield Phase

Field division: Forest Survey.
Work project: Survey of forest resources.
Line project: Growth and yield.
Purpose: To determine the current and probable future rate of timber growth and the productive capacity of the forest area.
Review of past work: Growth tabulations for the South Carolina units were started in 1937 and were about 40 percent completed by the end of the year.
Accomplishments during the past year: Growth tabulations were completed during the year for the South Carolina units and for the three eastern units in North Carolina.
Plans for next year: Growth tabulations will be completed for the mountain unit of North Carolina and state totals will be compiled.
Date of completion: Indefinite.
Assignment: G. E. Morrill, T. C. Evans.

RE - AP
Forest Survey

January 1, 1939

PROJECT STATUS SHEET

Forest Survey -- Depletion Phase

Field division: Forest Survey.
Work project: Survey of forest resources.
Line project: Depletion.
Purpose: Investigation to determine the rate at which the forest is being diminished through industrial and domestic use.
Review of past work: The mill-to-mill canvass of the forest industries in South Carolina was completed in 1937 and compilation of the data was begun.
Accomplishments during past year: Compilation of the South Carolina drain data has been completed. A complete list of sawmills in the state has been furnished the Bureau of the Census for their use in mailing questionnaires for the 1938 census of lumber production.

Drain field work was completed in North Carolina during the year. Over 3,000 sawmills and numerous non-lumber industries were located and contacted.

At the request of the Bureau of the Census, copies of individual mill records obtained by the Survey in North Carolina were sent to the Bureau to supplement their own information. This resulted in greatly increasing the number of mills and lumber production reported for the state.

Plans for next year: By a cooperative agreement between the Forest Service and the Bureau of the Census, this Station will receive and edit the Census questionnaires of 1938 lumber production for North Carolina and make such field checks as necessary.

A field canvass of South Carolina industries is also planned to obtain production data for 1937 and 1938 so that Survey records may be kept up to date.

Date of completion: Indefinite.
Assignment: E. V. Roberts, G. E. Morrill, T. C. Evans, E. B. Faulks, W. T. Hicks.

RE - AP
Forest Survey

January 1, 1939

PROJECT STATUS SHEET

Forest Survey -- Interpretation Phase

Field division: Forest Survey.
Work project: Survey of forest resources.
Line project: Interpretation.
Purpose: Analysis and interpretation of data and preparation of reports.
Review of past work: Preliminary analysis of South Carolina unit data was made in 1937 for reports on the forest resources of South Carolina on the Central South Carolina Project in cooperation with the State Forester and the Division of State and Private Forestry.
Accomplishments during past year: Analysis of South Carolina unit data was completed and first drafts of brief unit reports were prepared for the three units in the state. Assembly, organization and analysis of data for a state report for South Carolina was begun and working plans and outlines were prepared.
Plans for next year: Unit reports for all units in South Carolina and a state report are planned for this year. For North Carolina, unit reports are planned for at least the three eastern units.
Date of completion: Indefinite.
Assignment: E. V. Roberts, G. E. Morrill, T. C. Evans, E. B. Faulks, W. T. Hicks.

RI - AP
Water Utilization
Tree Species

January 1, 1939

PROJECT STATUS SHEET

Transpiration and Other Consumptive Uses of Water by Forest Cover

Field division: Forest influences research.
Work project: Water utilization by vegetation.
Line project: Transpiration and other consumptive uses of water by forest cover.
Purpose: To determine the effect of forest cover on transpiration and other consumptive uses of water as an integral part of the analysis of the hydrologic cycle, to be used in the analysis and interpretation of practical water conservation problems.
Review of past work: Measurements of loss of precipitation to the soil beneath forest canopies have been completed for four representative forest types on the Bent Creek Experimental Forest. A complete analysis of the three and one-half years' records are now in manuscript awaiting publication.

A number of orientation studies have been conducted within the field of transpiration measurement. Developments elsewhere have been followed carefully.

Plans for next year: Although the preliminary phase of the interception study is complete for the four types originally studied, extension of this work to additional forest types on the Coweeta Experimental Forest is planned for the future. Future work will include an intensive study of the relation of temperature, wind movement, saturation deficit, pressure. Studies are contemplated to determine the relation of vegetal characteristics such as age and condition class, basal area, crown projection area, crown density, etc., to interception losses.

During the coming year a working plan for studying transpiration will be prepared. This plan will consider for the Appalachian region measurement of transpiration by: diurnal fluctuation of streams, changes in the water table, soil moisture sampling, potometers and lysimeters, and direct measurement of vapor transpired.

Date of completion: Continuous.
Assignment: C. R. Hursh, H. J. Loughead.

RI - AP
Vegetation and Streamflow
Forest

January 1, 1939

PROJECT STATUS SHEET

Relation of Forest Cover to Streamflow

Field division: Forest influences research.
Work project: Influence of natural vegetation on streamflow.
Line project: Relation of forest cover to streamflow.
Purpose: To determine the effects of forestry and forestry practices upon the behavior of streams and quality of stream water, as related to the conservation of water resources for municipal, industrial, and recreational uses.
Review of past work: A comprehensive study of stream behavior in relation to land use on selected watersheds was begun in 1934. These drainages are located in the three major rainfall zones of the Southern Appalachian Mountain region. Within the highest rainfall zone characteristic of the most valuable protection forest type now under national forest administration, a major watershed installation has been developed as a part of the national program of forest influence investigations. Installations of scientific instruments for recharge and discharge measurements are being supplemented by studies of infiltration, soil moisture, and ground water.
Accomplishments during the past year: The analysis and interpretation of continuous records obtained to date have already contributed greatly to the field of forest hydrology. Light has been shed on some of the least understood problems relating to the flow of streams from forested areas. Basic data on water recharge and stream discharge of 15 drainages have been compiled for four years, furnishing usable coefficients of storm runoff for a number of land-use types. Basic data on stream discharge from forest areas have been put to practical uses on industrial and municipal projects.
Plans for next year: Several publications making practical applications of data obtained to date will be published during the coming year. Beginning July, 1939, a number of drainage areas shall have completed the five years standardization period and steps will be considered for making certain changes in the management and land use of the areas to obtain further records. The areas will be subjected to a detailed examination in the field; plans and recommendations for changing cover conditions will be drawn up, and a special conference will be called to criticize the plans before final arrangements are completed.
Date of completion: Continuous.
Assignment: C. R. Hursh, R. A. Hertzler, H. C. Creasman.

RI - AP
Climate
Forests

January 1, 1939

PROJECT STATUS SHEET

Local Effect of Forests on Climate

Field division: Forest influences research.
Work project: Effect of cover on climate.
Line project: Local effect of forests on climate.
Purpose: To determine the influence of forest vegetation upon the meteorological conditions of its immediate environment.
Review of past work: All meteorological records now being obtained as a part of the Station's watershed studies have furnished basic data for analysis of possible vegetation effects.

Within the Copper Basin of Tennessee six first-order meteorological stations are in operation, two in each of the three major vegetation zones of the area. Three of these stations were installed in 1934, the remainder in 1936. An additional 24 standard rain gages are being operated in the locality by the Hydrologic Data Division of the T.V.A. and by the Station. All of the above records are being compiled and kept up to date.

Accomplishments during past year: Present installations have been maintained. Four years' complete records from the Class A meteorological stations within the major vegetation zones of the Copper Basin have been compiled and a manuscript prepared on the result of the investigation to date.
Plans for next year: Extending the Station's studies in microclimates is limited by the personnel and equipment that can be put into data collection and analysis. The problems to be solved are unlimited. However, no plans are being made for expansion of the study other than can be conveniently corried out by present personnel as a part of other routine duties.

The orientation of the general field of local climates for the region will remain an active study. If personnel and equipment should become available, the following problems have very definite prospects of producing valuable results: (a) a study of heat accumulation above completely denuded areas, and its possible influence upon local precipitation, (b) fog and fog drip from forest vegetation as a source of water in the Southern Appalachians, (c) aspect as a factor in microclimates, with particular reference to forestry practices, and (d) wind change and temperature inversion as influenced by forest vegetation in the Southern Appalachians.

Date of completion: Continuous.
Assignment: C. R. Hursh.

RI - AP
Soil Stabilization
Roads

January 1, 1939

PROJECT STATUS SHEET

Road Bank Stabilization

Field division: Forest influences research.
Work project: Stabilization of soil.
Line project: Road bank stabilization.
Purpose: To determine practicable and inexpensive methods of permanently stabilizing road banks.
Review of past work: 1934 - Original studies demonstrating different method of preventing soil sloughing from newly made road cuts and fills were tried out on the Bent Creek Experimental Forest and on the Pine Mountain national forest road in Georgia.

During years 1935-37 - Additional tests of methods were made on extensive projects. Specials tests were made with cotton fabric, seed mixtures, fertilizers, etc.

Accomplishments during past year: The different road bank stabilization tests are serving as demonstration areas and are being visited regularly by many practical workers. Staff members have served in advisory capacity on numerous field projects, have trained and supervised two junior foresters for the Regional Office, and have made contacts to publicize and put research results into general practices.

A manuscript on low-cost slope erosion control was read before the National Highway Research Board and will appear in the proceedings of the organization. A technical note on slope erosion control was prepared and given wide distribution. Assistance was given in the preparation of the Forest Service Truck Trail Handbook, and another manuscript is in preparation for a circular on erosion control on national forest roads.

Plans for next year: Publicity and advisory services, demonstration of existing tests, promotion of widespread application of feasible methods to extensive projects, and tests of new designs of ditch and gutter construction and culvert outlets for protection of fills.
Date of completion: Continuous.
Assignment: C. R. Hursh, J. W. Wood, and T. F. Swofford.

RI - AP
F.C.S.
Preliminary Examinations

January 1, 1939

PROJECT STATUS SHEET

Preliminary Flood Control Examinations

Field division: Flood control surveys.
Work project: Flood control surveys.
Line project: Preliminary flood control examinations.
Purpose: Examination of watersheds to determine existence of flood problems and to locate the flood source areas.
Review of past work: The Department of Agriculture was first authorized to participate in flood control surveys by Section 6 of the Flood Control Act of June 22, 1936 (Public 738 - 74th Congress). Active work was, however, delayed until June, 1937, when funds were first made available. The preliminary report on the Pee Dee watershed was completed during 1937.
Accomplishments during past year: On watersheds for which this Station functions as chairman of the Field Committee, a report was completed for the Potomac River watershed and examinations made on the Big Sandy and Little Kanawha River watersheds. The reports on the Big Sandy and Little Kanawha were respectively about 85 percent and 70 percent completed in 1938. Some work was also done on the watersheds of the James, Smith, Roanoke, and Kanawha Rivers.

On watersheds for which this Station functions as a member of the Field Committee, the Forest Service contribution was completed for the Santee-Cooper River system. Some work was also done on the watersheds of Tar-Neuse and Cape Fear Rivers.

Plans for next year: Listed in approximate order of priority are the watersheds needing work during the forthcoming year:

Watershed	State or States
New River (above Bluestone Reservoir site)	N. C., Va., and West Virginia
Lieutenant Run and Poor Run	Virginia
Smith River	N. C. and Virginia
James River	Va. and West Virginia
Roanoke River	N. C. and Virginia

Date of completion: 1940 is estimated as probable date of completion of this work.
Assignments: H. J. Loughead.

RI - AP
F.C.S.
Watershed Surveys

January 1, 1939

PROJECT STATUS SHEET

Watershed Surveys

Field division: Flood control surveys.
Work project: Flood control surveys.
Line project: Watershed surveys.
Purpose: Detailed survey of approved watersheds to determine what needs to be done in the watersheds to retard runoff and to control erosion in the interest of flood control.
Review of past work: No work done until 1938.
Accomplishments during past year: This Station functions as a member of the Field Committee making a detailed survey of the Coosa River above Rome, Georgia, an area of approximately 4,000 square miles. Survey headquarters were established in Cartersville, Georgia, about September 15 and survey work started about this date. Due to difficulties encountered by other bureaus in obtaining personnel and equipment, progress was slow at the beginning; as these problems were remedied, constructive progress was made. Surveys on two small tributary drainages, John and Pettit Creeks, were completed and considerable progress made on the main watershed.
Plans for next year: Completion of the survey on the Coosa River project is anticipated. No commitments concerning new projects can be made since new work must be authorized by the Flood Coordinating Committee in Washington.
Date of completion: Completion of Coosa River survey is expected in 1939; similar work on other watersheds may go on for a number of years.
Assignment: H. J. Loughead, S. D. Beichler, M. M. Bryan, J. E. Keefus, R. D. Williams, L. K. Hill.

RS - AP
M-1(Ci)

March 10, 1938

FOREST SERVICE
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RESEARCH
INTERMOUNTAIN

PROJECT STATUS SHEET

Stand Improvement, Mountain Hardwoods

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Stand improvement.
5. Purpose of work: To develop standards for cultural operations, that will maintain and improve the growth rate and quality of established desirable components of juvenile stands of mixed species.
6. Review of past work: Past work in which the forest stands were the unit of observation showed that although cultural treatments resulted in improved conditions the findings could not be readily translated into terms of definite operation standards useful in practical application. Because individual crop trees are the basic unit of treatment, the approach was changed 3 years ago to testing the reactions of various types of crop trees to 4 different methods of weeding which were considered promising and which could be described by definite standards. Establishment of large scale tests under this new approach have been completed for 3 of the most valuable hardwood species. Less extensive work has been done with 3 additional species. Because other work has shown the necessity of doing early stand improvement, the above research has been limited to stands for 10 - 25 years of age.

   Additional stand improvement work has been limited to studies of (a) the influence of pruning various portions of the live crown on the subsequent growth of white pine, and (b) the results of liberation treatments on the growth rate of reproduction of this species.
7. Accomplishments during past year: (1) Establishment of the last extensive test of crop tree cleanings contemplated under the present program.

   (2) Delayed response to treatment was found to occur with young crop trees of white oak and white pine. In the latter species, effect of treatment was not marked until third growing season. By the fifth season however the average height growth made during the 5 years by untreated trees was only 75 percent of that made by those treated.

   (3) Sugar maple responded to crop tree cleanings during the first growing season, treated trees showing 2-2/3 as much d.b.h. increment as check trees. Differences in the influences of various kinds of crop tree cleanings did not become apparent during the first season, however.
8. Plans for next year: No new work will be started. Projects to be continued are (a) cleaning studies in young hardwoods, (b) pruning studies in white pine, and (c) liberation studies in white pine.
9. Date of completion: Determination of best cleaning methods for maintenance or improvement of growth rate of young hardwood crop trees to be completed 1943. The methods best suited to production of high quality wood will probably not be determined until 1948.

   Definite conclusions regarding the influence of green pruning on subsequent growth of white pine will be available by 1940.
10. Assignment: J. H. Buell.

RS - AP
M-1 (Ci)

March 10, 1938

PROJECT STATUS SHEET

Intermediate Harvest Cuttings, Mountain Hardwoods

1. Field division: Forest management.
2. Work project: Silcultural investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Intermediate harvest cuttings.
5. Purpose of work: To develop for second-growth hardwood stands beyond the juvenile stage standards of cultural operations that will maintain or benefit growth-rate and composition and produce a merchantable yield of small-dimension products.
6. Review of past work: Although in the past considerable work has been done, insufficient samples and lack of markets for small products have made it impossible to conduct the research on a scale commensurate with the needs. With the present knowledge in experimental design and the facilities and markets more fully developed, the experience in past work will be valuable in establishing more adequate experiments in the future. An outstanding result of past work has been the necessity for maintaining a secondary stand of carefully chose "trainers" to provide the competition necessary for maintenance of quality increment.
7. Accomplishments during past year: A study of a combined sawlog and pulpwood sale was conducted in a mixed oak type. The primary purpose was to determine the costs and economic possibilities of manufacturing oak pulpwood from tops and cull sections of trees containing sawlog material and from deformed and defective trees. All of the timber cut was removed primarily for improving the composition and quality of the residual stand. Computations thus far have resulted in preparation of volume tables showing both the total cubic foot and stacked cord volume in the tops of oaks of different sizes and the determination of converting factors from which the solid cubic content of stacked wood can be determined. The latter work showed that for the comparatively knotty and crooked bolts manufactured from limbs and cull trees, the solid cubic contents of stacked wood increases with the number of pieces per cord, and also with the percentage of the total number of sticks in round or unsplit form.

   Analysis of wood operation costs in man hours is under way.
8. Plans for next year: The woods operation costs of manufacturing oak pulpwood from improvement cuttings will be analyzed to indicate the conditions of stand volume and logging which are on the non-profit margin for this type of operation. New work to be started during the coming year will include the establishment of permanent sample plots to test various types of thinnings and improvement cuttings in second-growth cove hardwoods as to their effect upon the maintenance of volume and quality increment and the respective yields of small-dimension products.
9. Date of completion: (1) The oak pulpwood study will be completed during 1938. (2) Results from the new work in thinnings and improvement cuttings to be established during the year will be available late in 1939, insofar as the production of small-dimension products is concerned. Results of the effect of thinning methods on increment will not be available prior to 1944.
10. Assignment: J. H. Buell.

RS - AP
M-1 (Cr)

March 10, 1938

PROJECT STATUS SHEET

Harvest Cuttings, Mountain Hardwoods

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Harvest cuttings.
5. Purpose of work: To determine for mature timber types the silvicultural systems which will result in abundant desirable reproduction and produce the greatest sustained increment of high quality products.
6. Review of past work: Examinations of cut-over areas on National Forests and private land and establishment of controlled cutting experiments have shown that Appalachian hardwood types can be reproduced and perpetuated under either clear cutting with seed trees or by some form of partial or selection cutting. Which of these systems will produce the greatest sustained increment of quality products awaits determination by means of experimental cuttings. Past work has shown the dangers of quality deterioration in residual stands under partial cutting and that more research is needed to show how this can be controlled. The difficulties of determining under partial cutting those trees ready for harvest is an outcome of past work and has resulted in recent exploratory research in possibilities of tree classification for hardwoods.
7. Accomplishments during past year: A preliminary hardwood tree classification with white oak as the sample species was completed early last year. Tests under practical field conditions pointed to the need of certain improvements which have been begun.
8. Plans for next year: Work on the hardwood tree classification will be completed for white oak and sent to cooperating agencies for trial.

   A study of the factors responsible for the development of epicormic sprouts on residual trees after partial cutting will be conducted in stands cut over experimentally three years ago. These sprouts are primary causes of quality deterioration after partial cutting and the study should point the way to their control.
9. Date of completion: (1) Tree classification for white oak to be completed - 1938.

   (2) Factors influencing the development of epicormic sprouts - 1938.

   (3) Tests of influence of silvicultural system on sustained quality increment is a continuing long-time project. Earliest results expected - 1943.
10. Assignment: L. I. Barrett.

RS - AP
M-1 (Gr)

March 10, 1938

PROJECT STATUS SHEET

Determination of Growth and Mortality in Mountain Hardwoods

1. Field division: Forest management.
2. Work project: Mensuration investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Composition, growth, mortality, and yield of forest stands.
5. Purpose of work: The purposes of this project are: (1) to check and improve existing methods of determining forest growth in all aged stands of mixed species; (2) to determine by means of individual tree specifications the periods of time that have elapsed since the death of trees of different species.
6. Review of past work: Growth predictions form the fundamental basis for all sustained yield forest management plans and a review of past work shows that no really satisfactory method of predicting growth in all aged stands of mixed species has been devised, although several promising procedures have been developed. The determination of tree mortality has proved to be a serious weakness common to all methods. It has been apparent for some time that the most satisfactory and accurate procedure for development of growth predicting techniques and mortality determinations in all aged stands of mixed species must be based on careful long-time observations on permanent sample plots established in representative areas.

   Intensive work on this project was begun in 1933. Approximately 3,000 permanent plots were established in 5 different areas.
7. Accomplishments during past year: No work on this project has been conducted other than maintaining established permanent sample plots, and preparation of maps showing the location of plots within type and condition classes.
8. Plans for next year: Four growing seasons have elapsed since the first sample plots have been established. During the coming year it is planned to reexamine at least a portion of these plots to determine if a sufficient number of trees have died during the four years to provide a basis for preparation of individual dead tree descriptions. If so, analyses will be conducted for the purpose of setting up standard specifications for trees of different species which have died within the period.
9. Date of completion: (1) Determination of specifications for trees which have died within the four years will be completed during 1939. Field examinations will be made at intervals until sufficient mortality has occurred to set up standard dead tree specifications for the important commerical species.

   (2) Preliminary results on the development of growth production techniques will be available in 1940; final results will not be available prior to 1950.
10. Assignment: L. I. Barrett.

RS - AP
M-1 (Special Studies)
Cut-over Areas

March 10, 1938

PROJECT STATUS SHEET

Cut-over Area Analysis, Mountain Forests

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Cut-over area analysis, mountain forests.
5. Purpose of work: An analysis of stand conditions following cuttings of different kinds and degrees in different forest types in the mountain region, including: quantity and growth-rate of reproduction, by species and origin; growth-rate, crown expansion, and significance of residual stand; composition of reproduction following death of chestnut; and related subjects.
6. Review of past work: Field work by Station (1927-1929) and national forest administrative staffs (1929 and later) resulted in about 350 tallies of cut-over areas. Additional field work done on Stony Fork (Pisgah) cultural treatment plots and on Avons, Va., chestnut replacement plots to determine effect of crown expansion on reproduction. Analysis intermittent since August, 1935, active since September, 1937.
7. Accomplishments during past year: Preliminary analysis of 60 groups of Station plots in 1937 brought out significant or highly significant correlations between classes of reproduction and between number and basal area of residual trees; but none between free reproduction and residual stand.
8. Plans for next year: Analysis to be continued, using individual plot tallies instead of groups, with effort to determine tendencies toward change in composition (particularly as result of death of chestnut).
9. Date of completion: 1939.
10. Assignment: E. H. Frothingham.

RS - AP
M-4 (Ci)

March 10, 1938

PROJECT STATUS SHEET

Stand Improvement in Second-Growth Oak-Pine

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Piedmont oak-pine types.
4. Line project: Intermediate cuttings in second-growth.
5. Purpose of work: To determine the most efficient methods of maintaining and improving the desirable components of juvenile stands, and to develop methods of thinning for both stand improvement and the production of small-dimension products in second-growth stands beyond the juvenile stage.
6. Review of past work: New project in 1937. No past work done.
7. Accomplishments during past year: No work done.
8. Plans for next year: Establishment of experimental cuttings in pine pulpwood stands will be started. Six types of cutting will be tested. Three of them are designed to test the reproductive ability of various numbers of seed trees where the final purpose of management is pulpwood production. The remaining three treatments are designed to determine the yield both in growth and volume removed, under different degrees of cutting when the ultimate purpose of management is to produce sawtimber.
9. Date of completion: Project as a whole continuous but first results from seed tree cuttings will be available by 1941. First results from thinnings will be made available by 1943.
10. Assignment: L. I. Barrett and Norman E. Hawes.

RS - AP
M-4 (Gr)

March 10, 1938

PROJECT STATUS SHEET

Growth and Yield of Piedmont Oak-Pine Types

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Piedmont oak-pine types.
4. Line project: Growth and yield of Piedmont oak-pine types.
5. Purpose of work: To determine the rate of growth of stands of various densities and compositions and of individual trees having different characteristics and growing under the conditions common to the region.
6. Review of past work: This was a new project in 1937; hence "Accomplishments during past year" and "Review of past work" cover the same ground.
7. Accomplishments during past year: Collection of field data was completed for a study of the growth, yield, silvical, and botanical characteristics and management of Virginia pine. Volume tables and yield and growth tables for non-normal stands have been constructed from these data. A new form of yield equation was developed which simplifies the technique necessary to the preparation of non-normal yield tables. This equation was found equally applicable to loblolly pine.

   A method of tree classification for second-growth loblolly pine has been carried through the initial stages of computation.
8. Plans for next year: Computations on the mensurational phases of the Virginia pine yield study will be continued and material for a bulletin manuscript compiled. Work on the second-growth loblolly pine tree classification will also be continued.
9. Date of completion: Computations and preparations of a bulletin manuscript of the Virginia pine study will be continued during 1938. The second-growth loblolly pine tree classification will also be completed during the coming year.
10. Assignment: L. E. Chaiken and A. A. Downs.

RS - AP
M-4 (Cr)

March 10, 1938

PROJECT STATUS SHEET

Harvest Cuttings in Piedmont Oak-Pine Types

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Piedmont oak-pine types.
4. Line project: Harvest cuttings.
5. Purpose of work: To determine methods of harvesting mature timber that will produce the greatest sustained increment of quality material.
6. Review of past work: Thirty-two permanent sample plots were established in 1936 in a stand of mature shortleaf - hardwoods to test the influence of different kinds of cutting upon the establishment of desirable reproduction and increment of residual stand.
7. Accomplishments during past year: Maintenance of existing permanent plots only.
8. Plans for next year: Reexamination of reproduction established on existing plots will be made.
9. Date of completion: Results of cutting method upon reproduction establishment to be completed by 1940.
   First results of effect of cutting upon increment of residual stand will be available by 1942.
10. Assignment: L. E. Chaiken, Norman E. Hawes.

RS - AP
Fp

March 10, 1938

PROJECT STATUS SHEET

Artificial Reforestation, Mountain Hardwoods

1. Field division: Forest management.
2. Work project: Regeneration investigations.
3. Functional project: Mountain hardwoods.
4. Line project: Adaptation of species to sites.
5. Purpose of work: To determine the species best adapted to the artificial regeneration of (a) the abandoned agricultural lands of the Cumberland foothills of Kentucky and Tennessee, (b) the cut-over spruce lands of the high mountains.
6. Review of past work: Financial support for the conduct of planting research became available during fiscal 1937, so that direct research in reforestation has been under way for only one year. Prior to this time investigations were limited to a description and classification of the plantations established on the Biltmore estate in Buncombe County, N. C., which was published as U.S.D.A. Miscellaneous Publication No. 61, in 1930. A few small test plantations of coniferous species were established in the cut-over spruce type on Mount Mitchell, 1923 to 1931. However, due to lack of funds and personnel, results from these plantations have not yet been analyzed.
7. Accomplishments during past year: With the cooperation of the T.V.A. eight separate planting experiments were designed and locations for them chosen on land which is under the administration of the T.V.A. near Norris, Tenn. These experiments will test the adaptability of a large number of species, primarily hardwoods, to the various site conditions representative of the three major soil types occurring on the abandoned agricultural lands in the eastern foothills of the Cumberland. Planting of approximately 60 percent of the established plots will be completed during the current season.

   Procedure for making survival counts in forest plantations based on a system of random sampling is being developed on four different newly established plantations.
8. Plans for next year: Planting will be completed on the experiments near Norris, Tenn. First-year survival counts of those plots already established will be completed at the end of the 1938 growing season.

   A comparison of the results of making plantation examination by current methods as compared to a random method will be completed. This analysis will deal not only with the accuracy of the methods but with the comparative costs. Results will be issued, probably in the form of a technical note. An analysis of the planting problems in the cut-over spruce types will be conducted during the coming summer and used as the basis for designing the planting experiments.
9. Date of completion: (1) A comparison of methods for making plantation survival examinations will be completed during 1938. (2) Although the planting test under way in cooperation with the T.V.A. is continuous as a whole, significant results as to the adaptability of various species to sepcific sites will be made currently available. Important conclusions from this work should be obtained not later than 1940. (3) The problem analysis in the cut-over spruce types will be completed during 1938.
10. Assignment: L. S. Minckler.

RS - AP
M-4 (R)

March 10, 1938

PROJECT STATUS SHEET

Reforestation of Abandoned Farm Land in the Piedmont Region

1. Field division: Forest management.
2. Work project: Regeneration investigations.
3. Functional project: Piedmont oak-pine types.
4. Line project: Reforestation of abandoned farm land.
5. Purpose of work: To determine the factors affecting the natural regeneration of abandoned agricultural land, and the most efficient methods of artificially reforesting non-restocking abandoned agricultural lands.
6. Review of past work: New project in 1937. See Section 7.
7. Accomplishments during past year: A study of the factors affecting natural regeneration on abandoned fields showed that condition and extent of seed source were the most important factors. A desirable seed source was defined and it was found that with such a source present at least 1,000 seedlings per acre can be established for distances not over five chains from source and that at least 500 seedlings per acre can be established for distances not over seven chains.

   Standards for the proper storage of loblolly pine seed were established. These require that the seed be stratified for three months in moist media at temperatures of 32 to 40 degrees Fahrenheit.
8. Plans for next year: An intensive study of various methods of seed spotting will be conducted in two Piedmont areas. Loblolly, shortleaf, and possibly Virginia pine will be used. Correlated with this work will be a study of the site factor conditions responsible for seedling mortality.
9. Date of completion: The most important phases of the above project to be completed by 1941.
10. Assignment: Wm. E. McQuilkin and A. A. Downs.

RS - AP
M-3

March 10, 1938

PROJECT STATUS SHEET

Management Southern Pines - Coastal Plains

1. Field division: Forest management.
2. Work project: Silvicultural investigations.
3. Functional project: Coastal plain types.
4. Line projects: Harvest cuttings (Cr), intermediate cuttings (Ci), growth, yield, and mortality determinations (Gr), and regeneration (R).
5. Purpose of work: To study the growth, reproduction, and management of pines, particularly loblolly pine, and associated species, in the Middle Atlantic coastal region.
6. Review of past work: Reexamination of premanent sample plots established in partially cut stands of pine has indicated the considerable danger of mortality in residual trees which had suffered only apparent minor damage at the time of logging. 14 permanent sample plots to test the results of various types of harvest cuttings have been established in cooperation with private timber land owners. Ten of these have since been accidentally burned.

   A completed study has furnished volume, growth, and yield tables for non-normal stands of loblolly pine and has in addition provided sound recommendations for the measurement and management of this species for pulpwood production. Economic phases of producing pulpwood are also analyzed. A bulletin manauscript covering this study has been prepared for publications. Mortality studies in pine stands have been established on 200 permanent sample plots in cooperation with the Sumter National Forest.

   A plantation of 16,000 loblolly pine seedlings has been established to determine the influence of single parent characteristics upon the growth and survival of these seedlings.
7. Accomplishsments during past year: The second annual reexamination of the plantation established in connection with the loblolly pine one-parent heredity study was made.

   Cost production data obtained in 1931 from a coastal plain saw mill was analyzed to determine the relationship between age of trees and lumber value. It was found that lumber cut from trees over 80 years of age was worth approximately $5.50 more per M than the lumber cut from trees under 40 years of age. The volume of the upper grades of lumber was 50 percent of the total volume cut from the older trees, while for those 40 years of age and under the upper grades comprised only about 13 percent of the total cut.
8. Plans for next year: Due to lack of funds, work in this region for the coming year will be limited to maintenance of established experiments.
9. Date of completion: Preliminary results on the one-parent heredity study will be published in 1941.
10. Assignment: L. I. Barrett, L. E. Chaiken, and Norman E. Hawes.

RS - AP
Pf-2

March 10, 1938

PROJECT STATUS SHEET

Fire Behavior

1. Field division: Forest management.
2. Work project: Fire protection investigations.
3. Functional project: Fire behavior.
4. Line project: Behavior of fire.
5. Purpose of work: To develop methods of measuring the temporary or fluctuating fire danger variables and of integrating them into numerical ratings so that (a) fire control officers may accurately know when different types of detection and suppression organizations are justified, (b) fire control efficiency may be correctly rated, and (c) fire control may be financed on a sound basis.
6. Review of past work: Analysis of weather factors preceding severe fires and preliminary investigations of fuel and weather relations have been given some consideration in the past. During the past year major emphasis has been given to fire danger measurement.
7. Accomplishments during past year: The Appalachian Fire Danger Meter was devised and checked at 55 stations on eight forests in Regions 7 and 8. The Station cooperated with the Regions in planning the fire-weather network and instructing observers in the use of instruments and the danger meter. Analysis of the occurrence and behavior of 460 fires on the Pisgah National Forest, 1932 to 1937, by fire danger classes, provided a further check on the meter as did fire observers' reports of the behavior of going fires.

   At two complete fire-weather and inflammability stations, installed at the Bent Creek Experimental Forest last summer, the relations between fuel moisture and weather are being studied. A satisfactory fuel moisture indicator was developed in the form of flat basswood slats, the current weight of which indicates hardwood leaf litter moisture. A scales for directly determining stick moisture was invented.

   A preliminary danger meter was developed which incorporates fuel moisture into the danger rating and also forecasts danger.

   Methods of rating the severity of fire seasons were studied and a suggestion for correlating regional danger rating schemes was described in Fire Control Notes.
8. Plans for next year: It is planned to continue the check of the fire danger meter, work toward standardized methods of measurement through current field instruction, and increase the network of danger stations as funds permit. A field check will be made of the new meter that forecasts danger.

   A fire danger meter applicable to Piedmont and Coastal Plain forests will be devised and checked on two South Carolina units.

   Field tests of the fuel moisture indicator sticks and scales will be conducted on several forests.

   A new study, designed to isolate the effect of solar radiation as a drying agent, will be undertaken.

   Investigation of fuel moisture weather relations on different aspects by elevation classes will be started.
9. Date of completion: Check of fire danger meters, etc., 1940.
   Field check of fuel moisture indicator and scales, 1938.
   Effect of solar insolation on drying, 1939.
   Fuel moisture weather relations by aspect and elevation, 1943.
10. Assignment: Jemison, Byram.

RS - AP
Pf-1

March 10, 1938

PROJECT STATUS SHEET

Fire Control

1. Field division: Forest management.
2. Work project: Fire protection investigations.
3. Functional project: Fire control.
4. Line project: Presuppression and detection investigations.
5. Purpose of work: To develop methods for determining the standards of detection and speed and strength of attack required to meet the objectives of allowable burned acreage, and based upon different degrees of occurrence, visibility, fuel type, inflammability, and potential damage.
6. Review of past work: In the past, major emphasis has been placed on detection planning, including the development of techniques for visible area mapping and lookout-point value compilations. A study of visibility and weather, measured at approximately 45 points, is now entering its third year. Recent emphasis has been placed on rate of spread and resistance to control studies for Appalachian Mountain fuel types.
7. Accomplishments during past year: A report was prepared in which all of the detail steps necessary to plan a lookout system were set forth. The Plains haze meter, an instrument for measuring visibility distance in level country, was perfected and tested under field conditions in Kentucky and Missouri.

   The Station assisted Region 7 in devising a fuel type classification. Certain data, extracted from 1,568 fire reports which rangers classified by fuel types, were analyzed to show rates of spread and resistances to control. These data, essential for all phases of fire planning, are the first of this kind available for the Appalachian Mountain region.

   To provide additional information and to check the above fuel type classification the Station is cooperating with six forests in Regions 7 and 8 in obtaining fire behavior data from going fires. The Station initiated this study at ten training schools where 125 C.C.C. fire observers were instructed during the past year.
8. Plans for next year: Haze meter and weather records will be analyzed to establish the relation between visibility distance and (a) hour of day, (b) season, (c) geographical region, and (d) weather.

   The test of the Plains haze meter will be extended to the Coastal Plain of South Carolina.

   Continuation of the fire behavior study and analysis of observers' reports is planned.

   A new study to determine the relative visibility of standard smokes within the visual range is contemplated.

   The volume of smoke produced by a fire as related to fuel moisture, fuel type, and rate of spread will be commenced.
9. Date of completion: Analysis of haze meter - weather records, 1939.
   Plains haze meter test, 1939.
   Fire behavior study, 1941.
   Visibility of smoke within the visual range, 1940.
   The relation of volume of smoke to fuel moisture, fuel type, and rate of spread, 1940.
10. Assignment: Jemison, Byram.

RS - AP
Pf-3

March 10, 1938

PROJECT STATUS SHEET

Fire Damage

1. Field division: Forest management.
2. Work project: Fire protection investigations.
3. Functional project: Effects of fire.
4. Line project: Fire damage investigations.
5. Purpose of work: To ascertain the effect of fire on standing timber, reproduction, other vegetation, and site, in order to furnish information basic to the formulation of sound fire prevention and control plans and policies, to appraise fire damage, and to determine the value of fire as a silvicultural agent.
6. Review of past work: Past investigations have included studies of tree mortality following fire and physical damage to vegetation on experimentally burned sample plots. During the past year emphasis was given to a cooperative study with Forest Pathology to determine a method of predicting the amount of cull in white oak following fire.
7. Accomplishments during past year: Analyses of current sample plot remeasurements were made to show mortality following fire in uneven-aged hardwoods.

   The relation between cull in white oak and wound width, age of wound, and diameter at time of wounding was established in a cooperative study with Forest Pathology.
8. Plans for next year: Plans call for a preliminary analysis of records from Coastal Plain plots, some of which have been burned annually for the past seven years.

   No expansion of fire damage field work is contemplated for next year. However, one sample plot will be reburned during the spring fire season and later compared with unburned and single-burned plots.
9. Date of completion: Data on mortality of hardwoods following a light fall fire will be available in 1940; following a severe spring fire, in 1942.

   Mortality on burned and unburned Coastal Plain plots, 1939.
10. Assignment: Jemison.

RE - AP
Forest Survey

March 10, 1938

PROJECT STATUS SHEET

Forest Survey

1. Field division: Forest Survey.
2. Work project: Survey of forest resources.
3. Functional project: Volume, growth, and depletion of forests; formulation of policies to guide forest land use, community, and industrial development.
4. Line project:
5. Purpose of work: To collect, compile and analyze data on the volume, growth and depletion of the forest resources in the territory of the Station in conformance with the general plans of the national Forest Survey.
6. Review of past work: The Forest Survey organization was established at this Station in April 1936. Field work was begun in eastern South Carolina in July 1936 and by the end of the year all of the State not previously covered by the Southern Station (approximately 15 million acres) had been completed and the field work extended to the Piedmont section of North Carolina. Tabulation of the South Carolina data was well under way by the end of the year.
7. Accomplishments during past year: Field work was completed in all of North Carolina east of the mountains (approximately 25 million acres). The field organization was disbanded early in December because of lack of funds.

   The basic tables of area and volume were completed for the South Carolina units and the machine tabulations for the North Carolina units were approximately one-half completed.

   The depletion field work was completed in South Carolina during the year and preliminary summaries of depletion were compiled.

   Growth calculations for the South Carolina units were begun and were approximately 40 percent completed by the end of the year.

   Special tabulating jobs and reports were completed during the year for a preliminary report on the forest resources of South Carolina and the Central South Carolina Project.
8. Plans for next year: Approximately 70 million acres remain to be covered in the territory of the Station. Field work will be resumed as soon as funds are available.

   Final computations on growth and drain in South Carolina will be completed early this year. It is planned to publish brief statistical reports on each of the units and a complete report for the State during the year. Computations should also be completed for the three units covered in North Carolina and statistical releases are planned for these units.
9. Date of completion:
10. Assignment: E. V. Roberts, G. E. Morrill, W. T. Hicks, A. D. Toler, P. L. Davis.

RI - AP
F.C.S. (Prelim.)

March 10, 1938

PROJECT STATUS SHEET

Preliminary Flood Control Surveys

1. Field division: Flood control surveys.
2. Work project: " " " .
3. Functional project: " " " .
4. Line project: Preliminary surveys.
5. Purpose of work: Preliminary examination of drainage basins for run-off and waterflow retardation and soil erosion prevention.
6. Review of past work: The Department of Agriculture was first authorized to participate in flood control surveys by Section 6 of the Flood Control Act of June 22, 1936 (Public 738 - 74th Congress). Active work was, however, delayed until June 1937, when funds were first made available.
7. Accomplishments during past year: Preliminary flood control surveys on three major drainage basins are now complete or will be completed within the immediate future. These drainages include the Pee Dee River and tributaries in North Carolina, South Carolina, and Virginia; the Potomac River and tributaries in Virginia, Maryland, District of Columbia, West Virginia, and Pennsylvania; and the Santee River, including the Cooper drainage, in North Carolina and South Carolina. The report on the Pee Dee River basin is complete and the reports for the other two drainages are nearing completion.
8. Plans for next year: Providing present flood control survey activities are continued and funds are made available, surveys on the following list of drainage basins are contemplated for the forthcoming year:

Drainage Basin	State or States
James River and tributaries	Virginia and West Virginia
Roanoke River	Virginia and North Carolina
Tar-Neuse River and tributaries	North Carolina
Cape Fear River	North Carolina
Kanawha River and tributaries	West Virginia, Virginia, and North Carolina
Big Sandy River and tributaries	Kentucky and West Virginia
Tennessee River and tributaries	Tennessee, North Carolina, Virginia, Kentucky, Georgia, Alabama, and Mississippi.

9. Date of completion: 1940 is estimated as a probable date of completion for this work.
10. Assignment: C. R. Hursh, Harvey J. Loughead, and Leland K. Hill.

RI - AP
Watershed Investigations
Hydrology

March 10, 1938

PROJECT STATUS SHEET

Major Watershed Installation in a National Program of Forest Influence Investigations

Coweeta Experimental Forest

1. Field division: Forest influences.
2. Work project: Water behavior.
3. Functional project: Forest.
4. Line project: Major watershed studies.
5. Purpose of work: The Coweeta Experimental Forest is being developed into a completely controlled watershed for studies in a national program of forest influence investigations.
6. Review of past work: The first period of development on the watershed was a building program of streamflow measuring installations. Continuous records of streamflow on individual drainage areas were obtained during the first three years of active operation.

   Unit hydrographs, stream hydrographs, and various charts have been made showing a comparison of run-off from the different drainage areas. Also drainage area constants and coefficients were determined for the separate drainage areas by the application of rational run-off formulae.
7. Accomplishments during past year: The original streamflow measuring installations have been operated and maintained. Three new weir installations, Nos. 20, 22, and 28, and one rating station O, on Coweeta Creek near the boundary of the experimental forest were installed. Weir installation No. 21 is under construction. Hydrological data from the individual drainage areas have been compiled and are being analyzed with objectives similar to those presented for small watersheds. The studies on the Coweeta Experimental Forest differ from those on the Bent Creek Experimental Forest and Copper Basin Experimental Area in that on the Coweeta Area completely controlled watershed studies are the objective.
8. Plans for next year: Streamflow measurements and watershed standardization for the Experimental Forest will be continued. Eight additional streamflow gauging stations within the area will be installed. The plan is to equip all of the usable tributaries of the Coweeta Watershed with streamflow measuring devices for subsequent use in studies of forest management practices on streamflow.
9. Date of completion: Streamflow regulation studies for all drainages will be continued under the five-year period as originally planned, or until sufficient data are obtained for the standardization of individual areas. Once a reliable comparison of streamflow for existing forest cover has been established for individual drainages, the plan is to apply various kinds of treatment to the forest cover in order to determine the effect of forest management on streamflow regulation and soil erosion. The streamflow records of a number of these streams already indicate that they may be sufficiently well standardized to proceed with the second phase of the study in which the present forest cover will be changed. However, until this point is definitely established, no changes will be made on any of the watersheds.
10. Assignment: C. R. Hursh, L. K. Hill, R. A. Hertzler.

RI - AP
Watershed Investigations
Hydrology

March 10, 1938

PROJECT STATUS SHEET

Small Watershed Studies

1. Field division: Forest influences.
2. Work project: Water behavior.
3. Functional project: Forest.
4. Line project: Small watershed studies.
5. Purpose of work: To determine streamflow regulation on forested and other land-use areas, and the effects of changes in land-use on these areas.
6. Review of past work: The Bent Creek Experimental Forest and the Copper Basin Experimental Area have been intensively developed for studies on streamflow behavior. The first period of development has been one of field installations and in cooperation with other research divisions, the construction of roads and trails within the areas, making accessible the more remote sections of the forest. Continuous records of streamflow on individual drainage areas have been obtained during the first two and one-half years of active operation.
7. Accomplishments during past year: (A) Bent Creek Experimental Area: The original streamflow measuring installations were operated and maintained. Improvements were made in all weir installations; stilling wells were removed from stilling basins, placed in channel banks and inclosed in new wooden frame shelter houses. A land-use change in the form of cultivation was made on approximately one-half the area of drainage No. 8.

   (B) Copper Basin Experimental Area: In addition to continuous operation and maintenance of all installations, improvements were made at weirs 1, 2, and 3. The stilling wells were removed from ponding basins, placed in channel banks and inclosed in new wooden frame shelter houses. Parshall flumes 5 and 6 were replaced by new concrete San Dimas flumes.

   Numerous graphs have been constructed showing comparisons of run-off for various land-use areas, also drainage area constants and coefficients have been determined for the individual areas by the application of rational run-off formulae.

   Hydrological data have been compiled and are being analyzed for all storms greater than one-half inch precipitation, with the objective of comparing the amount of streamflow behavior afforded by the different land-use types. It has been found that land depleted by erosion and with inadequate vegetative cover will produce from 10 to 20 times the peak run-off that is produced by similar storms on similar drainage areas controlled by forest or other complete vegetative cover.

   Peak flow data from four uniform land-use types have been used in making frequency curves as follows: (1) peak discharge as percentage of precipitation, (2) maximum peak discharge in c.f.s. per acre and per square mile. The practical application of results obtained cover many phases of hydraulic engineering and land-use problems. The results may be used in the estimating of streamflow capacities for bridges, culverts, syphons, spillways of dams, and diversion weirs, and minor engineering structures. These curves show the relation of run-off from various land-use types.

(Over)

8. Plans for next year: Streamflow measurements and watershed standardization for the experimental areas will be continued. Bent Creek weir installation #4, and Copper Basin Parshall flume #4 will be replaced by concrete San Dimas flumes, and additional streamflow gauging stations in the Bent Creek area will be installed.
9. Date of completion: Studies in all drainages will be continued under the five-year period as originally planned, or until sufficient data are obtained for the standardization of the individual areas in order to determine watershed factors for streamflow regulation. After standardization, land-use changes are planned.
10. Assignment: C. R. Hursh, L. K. Hill, R. A. Hertzler.

RI - AP
Climate

March 10, 1938

PROJECT STATUS SHEET

Local Climate as Influenced by Vegetation

1. Field division: Forest influences.
2. Work project: Climate (micro).
3. Functional project: Forests.
4. Line project: Local climate as influenced by vegetation.
5. Purpose of work: To determine the influence of forest vegetation upon the meteorological conditions of its immediate environment.
6. Review of past work: Meteorological records now being obtained as a part of the Station's watershed studies furnish basic data for analysis of possible vegetation effects.

   Within the Copper Basin of Tennessee six first-class meteorological stations are in operation, two in each of the three major vegetation zones of the area. Three of these stations were installed in 1934, the remainder in 1936. An additional 24 standard rain gages are being operated in the locality of the Copper Basin by the Hydrologic Data Division of the T.V.A. and by the Station. All the above records are being compiled and kept up to date.
7. Accomplishments during past year: Present installations have been maintained. Two years' complete records from the Class A meteorological stations within the major vegetation zones of the Copper Basin have been compiled and a manuscript prepared on the result of the investigation to date.
8. Plans for next year: Extending the Station's studies in microclimates is limited by the personnel and equipment that can be put into data collection and analysis. The problems to be solved are unlimited. However, no plans are being made for expansion of the study, other than can be conveniently carried out by present personnel as a part of other routine duties.

   The orientation of the general field of local climates for the region will remain an active study. In case personnel and equipment should become available the following problems have very definite prospects of producing valuable results: (a) a study of heat accumulation above completely denuded areas, and its possible influence upon local precipitation, (b) fog and fog drip from forest vegetation as a source of water in the Southern Appalachians, (c) aspect as a factor in microclimates, with particular reference to forestry practices, and (d) wind changes and inversion as influenced by forest vegetation in the Southern Appalachians and its practical significance upon land use.
9. Date of completion: Continuous.
10. Assignment: C. R. Hursh, _____.

RI - AP
Water Cycle
Transpiration-Evaporation

March 10, 1938

PROJECT STATUS SHEET

Transpiration by Forest Vegetation and Evaporation From Forest Soils

1. Field division: Forest influences.
2. Work project: Water utilization and consumption.
3. Functional project: Trees.
4. Line project: Transpiration by forest vegetation and evaporation from forest soils.
5. Purpose of work: To determine the relation of forest vegetation to water discharge through transpiration by forest vegetation and direct evaporation from forest soils. These studies should be correlated with forest type, age, density, aspect, elevation, and climatic conditions prevailing under these separate conditions.
6. Review of past work: Preliminary study methods have been tested during the past three years. None of the methods tried were of sufficient intensity to furnish reliable data upon the magnitude of these water losses or a correlation to vegetal and climatic factors. Acceptable methods of study for the Southern Appalachian Mountain Region were indicated which will be of great value to future more intensive work.
7. Accomplishments during past year: A brief study of the diurnal fluctuation of stream hydrographs was initiated. This study has not progressed sufficiently far to yield any definite results.
8. Plans for next year: Intensive transpiration-evaporation studies for the forthcoming year shall proceed along at least four general lines of approach. The contemplated methods of study are: (1) direct measurement of water vapor transpired, (2) calculation of transpiration and/or evaporation through soil moisture sampling and a determination of soil moisture movements, (3) analysis of diurnal fluctuation of stream head discharge graphs, and (4) potometer or lysimeter studies (to be used only to a very limited extent because of excessive cost and complexity of installation). Local conditions will often determine the most acceptable and reliable method of approach. Since no universally accepted method for transpiration-evaporation studies has yet been devised, the different study methods will supply invaluable checks as to the reliability of the results by the different methods.
9. Date of completion: 1943 is estimated as a probable date of completion for this work.
10. Assignment: Harvey J. Loughead.

RI - AP
Water Cycle
Interception

March 10, 1938

PROJECT STATUS SHEET

Interception of Precipitation by Forest Vegetation

1. Field division: Forest influences.
2. Work project: Water utilization and consumption.
3. Function project: Trees.
4. Line project: Interception of precipitation by forest vegetation.
5. Purpose of work: To determine the loss of precipitation to the soil beneath forest vegetation and to derive a method by which this loss can be computed for the forest types found within the Southern Appalachian Mountain Region. This phase of the watercycle is an integral part of the more comprehensive approach to the general water utilization and consumption problems for this region.
6. Review of past work: The preliminary phase of this study is complete and a practical method of computing this loss of precipitation is now available for the four forest types studied. Preliminary results of the first three years' records for two of the forest types studied were presented in this Station's 1936-1937 Annual Report.
7. Accomplishments during past year: During the past three and one-half years field records were completed and the preliminary phase of this study for these types terminated. A complete analysis of the three and one-half years' records was made, the results of which are now in manuscript form and awaiting publication. This analysis showed a very definite correlation between the amount of intercepted precipitation and the total precipitation per storm. Significant differences in interception between some types and some seasons were also established. A supplementary study of bole drainage indicated that this quantity for the forest types studied ranged between .9 and 3.3 percent of the precipitation. Regression equations for computing interception for the forest types studied are ~~not~~ NOW available.
8. Plans for next year: Although the preliminary phase of this study is complete for the four types originally studied, an extension and expansion of this work is contemplated for the future. Future work will include a more intensive study of the relation of climatic conditions such as temperature, wind movements, saturation deficit, pressure, etc., to interception. Other studies are also contemplated to determine the vegetal characteristic, such as forest type, basal area, crown projection area, crown density, etc., which is the best vegetal index to interception losses. The results of this work should greatly improve the usefulness of the results of the preliminary phase of this work by broadening the scope of application of these results.
9. Date of completion: 1941 is estimated as a probable date of completion for this work.
10. Assignment: Harvey J. Loughead.

RI - AP
Road Bank Fixation

March 10, 1938

PROJECT STATUS SHEET

Road Bank Stabilization

1. Field division: Forest Influences.
2. Work project: Soil stability.
3. Functional project: "
4. Line project: Road bank stabilization.
5. Purpose of work: To determine practical methods of stabilizing road banks.
6. Review of past work: 1934 - Original studies demonstrating different methods of preventing soil sloughing from newly made road cuts and fills were tried out on the Bent Creek Experimental Forest, and on the Pine Mountain National Forest road in Georgia.

   1935 - Additional tests of methods made on the Coweeta Experimental Forest, the Bent Creek Forest, and on the Burton Lake Road of north Georgia.

   1936 - Additional methods tested out on the Coweeta Forest.

   1937 - Additional methods, including open mesh cotton cloth, tried on the Coweeta Forest.

   The above experiments have been visited by scores of C.C.C. camp foremen, rangers, and highway department men, who have studied the tests with the view of selecting and adopting the methods suitable to particular localities and conditions. This research was the beginning of road bank stabilization in Western North Carolina. The practical applications have been taken up by different conservation and highway agencies and may now be said to be of general application in the region.
7. Accomplishments during past year: The different road bank stabilization tests are still serving as demonstration areas and are being visited regularly by practical workers. Staff members have served in advisory capacity on field jobs of the T.V.A. and National Forests. New methods tried out during the year include the use of open mesh cotton cloth, seed mixture, and fertilizer tests.
8. Plans for next year: Publicity and advisory service. Demonstration of existing tests, promotion of widespread application of best methods. Tests of new ideas on roads not yet stabilized on experimental forests.
9. Date of completion: Continuous.
10. Assignment: C. R. Hursh, R. A. Hertzler, and K. A. MacKichan.

RI - AP
Watershed Investigations
Hydrology

March 10, 1938

PROJECT STATUS SHEET

Analysis of Hydrological Records and their Practical Application

1. Field division: Forest influences.
2. Work project: Water behavior.
3. Functional project: Forest.
4. Line project: Analysis of hydrological records and their application.
5. Purpose of work: This project is in part the statistical analysis of data collected and compiled in the course of the Station's watershed studies. However, the project also includes a developmental study of formulae required in solving for relative effects of the various watershed factors influencing streamflow. Also the project includes the development of practical methods of applying these formulae to the solution of existing regional problems.
6. Review of past work: Prior to 1936 analysis was restricted to a study of individual storms through rational formulae, comparison of base flow and peak flow, etc. These earlier studies brought out trends and relationships that have subsequently been substantiated through statistical analysis.
7. Accomplishments during past year: An intensive research was made into the field of watershed data analysis. Two original contributions to the field of small watershed studies have resulted from this research: (1) an application of the Unit Hydrograph Principle to small watersheds was made and analyzed for the purpose of disclosing correlations between the shape of the distribution graph, especially the peak percentage and width of base, with the physical characteristics of the drainage areas. Pluviagraphs were constructed to test the accuracy of the composite distribution graphs, and to determine the usefulness of the pluviagraph in the analysis of surface run-off phenomena. The results of this study will be published in the near future.

   (2) A preliminary study was made of the derivation of hydraulic equations to determine the amount of run-off or the proportionate part of the peak discharge contributed by different land-use areas within the drainage area. The reduction in the peak discharge or flood stage, that might be expected from changes in land-use and land management practices, was then computed by the use of these formulae. The results of this study indicated that for the areas studied a pronounced reduction in flood stages could be expected and the costs of such a program would be commensurate with the benefits derived from decreased flood damges, increased productivity of the land, restoration of land and property values, and the conservation of soil and water resources.
8. Plans for next year: (1) The continuation of statistical analysis of all storm run-off records; (2) unit hydrograph, distribution graph, and pluviagraph analysis, which indicate the constant behavior of run-off from individual drainage areas, and permit a comparison of different storms within the drainage area; (3) analysis of drainage area infiltration capacities which are a more precise determination of the constancy of streamflow behavior on an individual drainage area and at the same time permit a comparison of different drainage areas for different storms. This method lends itself to statistical analysis; (4) analysis of drainage area coefficients and constants to be used in rational run-off formulae; (5) analysis of

(Over)

run-off from different land-use types to determine the amount of run-off or proportionate part of the peak discharge contributed by each land-use area within the drainage area.

9. Date of completion: Continuous. It is anticipated that during the forthcoming year sufficient basic hydrological data will be analyzed to contribute significant and well substantiated results to the subject of streamflow regulation.
10. Assignment: C. R. Hursh, L. K. Hill.

RI - AP
Watershed Investigations
Hydrology

March 10, 1938

PROJECT STATUS SHEETS

Compilation of Records

1. Field division: Forest Influences.
2. Work project: Water behavior.
3. Functional project: Forest.
4. Line project: Compilation of hydrological and meteorological records.
5. Purpose of work: The purpose of this work is currently to compile hydrological and meteorological data obtained in the course of the Station's Forest Influence studies in such form as to expedite its maximum usefulness for further scientific analysis.
6. Review of past work: The following records have been checked and compiled for the Coweeta, Bent Creek, and Copper Basin areas:
   A. Precipitation: (1) amounts for individual storms for all watersheds, by months, seasons, and years, (2) time of beginning and ending, duration, and maximum 20-minute intensity of each storm.
   B. Streamflow: (1) total daily discharge for each weir installation in cubic feet, total discharge in cubic feet per square mile by days, months, seasons, years, (2) watershed area inches and percent of precipitation, by months, seasons, and years.
7. Accomplishments during past year: After testing out different procedures of compiling and filing records, suitable forms were prepared and printed in quantity. A computing force has been trained in checking original field records and compiling the necessary data on the prepared forms. Systems for filing of the original hydrographs have been developed.
8. Plans for next year: Routine compilation of all records will continue. In order to make the storm run-off records available for further theoretical analysis the following procedure will be used, the plan being to have all storm records for all watersheds available for use by July 1, 1938.
   A. All precipitation intensity records for individual storms will be currently compiled on the basis of the amount of precipitation during each 20-minute interval of the storm.
   B. All storm hydrographs are to be currently compiled on the basis of the mean discharge for suitable time intervals in such a manner as to permit independent reconstruction of the original hydrograph from the tabulated data.
   C. All other records to be currently compiled on suitable forms prepared for the purpose.
9. Date of completion: Continuous. Yearly records are to be ready for detailed analysis at least three months after the end of each fiscal year.
10. Assignment: C. R. Hursh, L. K. Hill.